WebGIS, Kigali

12 July 2017
Rwanda

A country of 1000 hills - a middle-income nation with its Vision 2020

Kigali City, a green, clean and secure City in Africa

**Rwanda**
- Area: 26,338 km²
- Population: 12M
- Density: 435/Km² (29th and 1st in Africa)
- History: Genocide against Tutsi of 1994
- Economy: GDP 2012: $7.103 billion, $619 per capita

**Kigali**
- Area: 730 Km²
- Population: 1.3M
- 3 Districts into 35 Sectors, 161 Cells
- 70% rural while ¾ of its population are urban dwellers.
- Growth rate of city is 10.7%
KIGALI
PRESENT

731 km²
Kigali City Area

1.3 million
Household Size: 4.8

3 districts
Nyarugenge
Gasabo
Kicukiro

0.5 million
Number of jobs in 2011

1,778 p/km²
Gross Density

Nature areas:
• 19% wetlands
• 31% > 20% slope

50% natural cons

19% of urban area in Kigali encroaches in land unsuitable for development

Developable land: ONLY 30-35%
KIGALI CONCEPTUAL MASTER PLAN

City Concept Plan
- Kigali City Concept Plan provides a long-term ‘Vision’ for the City

City Master Plan
- Detailed Master Plan translates the broad long-term strategies of the Concept Plan into detailed land use plans to guide the urban development.

City Zoning Plan
- A Zoning Plan is a gazetted plan translated from the Detailed Master Plan to regulate the development of each land parcel within the City.
Total Area: 731 km²
City Pop.: 1.3 million (2011)
Household size: 4.7
Gross Density: 1778 p/ km²

Rwanda
Area: 26338 Km²
Pop: 11.7 mil

• 83% Natural/Rural
• 17% Urban area
• 7% Unplanned areas
WebGIS

• WebGIS system is a system which uses web technologies to communicate among different components of the system.

• It originates from a combination of:
  • Web technology and
  • Geographical information systems GIS

→ WebGIS is the Distributed information system.

→ Launched 2013
# System Architecture of WebGIS – Silverlight

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core presentation framework</td>
<td>Components and services oriented toward the UI and user interaction, including user input, lightweight UI controls for use in Web applications, media playback, digital rights management, data binding, and presentation features, including vector graphics, text, animation, and images. Also includes the Extensible Application Markup Language (XAML) for specifying layout.</td>
</tr>
<tr>
<td>.NET Framework for Silverlight</td>
<td>A subset of the .NET Framework that contains components and libraries, including data integration, extensible Windows controls, networking, base class libraries, garbage collection, and the common language runtime (CLR).</td>
</tr>
<tr>
<td></td>
<td>Some parts of the .NET Framework for Silverlight are deployed with application. These &quot;Silverlight Libraries&quot; are assemblies not included in the Silverlight runtime and are instead shipped in the Silverlight SDK.</td>
</tr>
<tr>
<td></td>
<td>When Silverlight Libraries are used in application, they are packaged up with application and downloaded to the browser. These include new UI controls, XLINQ, Syndication (RSS/Atom), XML serialization, and the dynamic language runtime (DLR).</td>
</tr>
</tbody>
</table>
# System Architecture of WebGIS

![Diagram of Silverlight architecture]

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<tr>
<td>Installer and updater</td>
<td>An installation and update control simplifies the process of installing the application for first-time to the users, and subsequently provides low-impact, automatic updates.</td>
</tr>
</tbody>
</table>

Illustration shows these components of the Silverlight architecture along with related components and services.
System Architecture of WebGIS

1. The application is a typical HTML which runs under the IE browser.
2. There are markups which instantiates the silverlight plug-in.
3. User interacts with the silverlight application it sends event to JavaScript system or to the .NET system.
4. The program code which is either in JavaScript or .NET can make calls to the silverlight run-time and achieve the necessary functionalities.
5. XAML will be read and parsed by the silverlight runtime and then rendered to the browser.
1. ArcGIS API for Silverlight enables to build rich, dynamic Silverlight-based web application on top of GIS services.

2. The ArcGIS API for Silverlight connects to and leverages map services and other related GIS services that are published using ArcGIS for Server, ArcGIS Online, Portal for ArcGIS, and other consumer mapping services.
GIS Services

- Existing Web Service
- Kigali City master Plan Public
- Parcel WebService
- Proposed Webservice
www.masterplan2013.kigalicity.gov.rw
WebGIS-SMS System

- The web GIS SMS application uses the GSM communication protocol to receive and send Messages.
- The GSM SIM card is connected to the server using an USB dongle. A Third party SMS server DIAAFAN is used to listen to the GSM port and serve Messages received to the SIM card.
- The received messaged is stored in SQL Server.
- The database is created with Service broker option enabled which will send the data to the listener (SMS windows service).
- Windows service will process the SMS content and retrieve the Parcel information from the ArcGIS Rest services published. The retrieved parcel information would then sent back to the sender.

Dependencies
GMS SIM card is used for sending and receiving the messages

Limitations
The GMS based message service is suitable for messages ranging from 10-20 per day and not cost effective. Instead, an SMS gateway would give cost effective service.
Maintenance - WebGIS

• To keep the system robust, effective maintenance of the WebGIS server becomes essential.

• CoK WebGIS maintenance team may need to perform the following four major activities whenever required during upgrading or configuration of the system:
  1. Publishing of Web Services
  2. Changing the WebGIS Login Password
  3. Configuring the email address of WebGIS feedback form
  4. Configuring the Zone map layer number in web.config file.
  5. Update the parcel shapefile as it keeps changing

• Team needs to have basic knowledge on ArcGIS and WINDOWS
• Server maintenance
• Team needs to have good knowledge on ArcGIS desktop application
Output and Impacts of WebGIS

- Eased public access to the Master Plan specifically to the zoning requirements for individual plots giving the public reliable information on their development rights and obligations.
- Eased service provision by eliminating the need to physically visit the City offices to obtain information in regard to development compliance with the Master Plan.
- Increased interoperability and transparency in service provision as the WebGIS is interlinked with the National Land Management system and the COK Construction Permitting Management System.
- Addressed possible cases of fraudulent sale of properties that do not meet requirements for development.
- Addressed possible cases of encroachment onto environmentally protected areas as these are restricted zones for development.
- Improved the database management in regard to implementation of the City Master Plan.

Stakeholders

- Government agencies involved in land management, housing and urbanization.
- Non-Governmental Development Partners.
- Land owners and potential developers/investors.
- Professionals (individuals and bodies) involved in land management, housing and urbanization.

Cost

The WebGIS has the following main categories

- ArcGIS server - USD 50,000
- Application development - USD 50,000
- Training and maintenance - USD 20,000
- Hardware - USD 7,148
- Co-location service per year in national data center - USD 6,073
- Upgrade of the System USD 59,826

Total Cost - USD 193,047
WebGIS

Transferability

• It is easily transferable as the background code/software is easily customized to the needs of the user and is currently and locally managed by the City.

• As a precondition, any City keen on using the WebGIS must at least have:
  1. A Master Plan in place or under development.
  2. An administration and general public willingness to embrace the use of IT in improved service delivery.
  3. A strong and secured IT infrastructure backbone e.g. Fiber connectivity, cyber security
  4. An enhanced decentralization policy that eases general governance and service provision.

Challenges

• Silverlight technology;
• Mobility of the system;
• Regular update of the changes in parcels.

Citizen Well-being

• Ease of access to services, accurate and special information
• Transparency and Reliability in information dissemination
• Save their money and time
• Ease Master Plan implementation,
• It can be accessed wherever anyone is can get a service through internet.
• It promotes the effectiveness of public services
THANK YOU

www.masterplan2013.kigalicity.gov.rw