Demo: A Hyperlocal Mobile Web for the Next 3 Billion Users

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ABSTRACT

Despite increasing mobile Internet penetration in developing regions, growing web page complexity and the lack of optimization from remote content providers make the web experience poor in these areas. The high relative bandwidth cost, poor network performance, and lack of relevant local content combine to dampen the demand for the Internet and services it enables. In this paper we propose GAIUS, a content ecosystem enabling efficient creation and dissemination of locally relevant web content. At its core, GAIUS consists of the following innovations: a locally sustainable content ecosystem, and MAML, a web specification language that simplifies web pages to reduce costs and lower barriers for content creation.

CCS CONCEPTS

• **Networks** → **Network architectures**; • **Information systems** → **Markup languages**.

1 INTRODUCTION

Global broadband penetration currently stands at 51.2%. However, the diverse stakeholders within the Internet ecosystem have had severe difficulties in enabling locally relevant Internet content in emerging markets. According to ICANN [5], there are 4.5 domains per 1000 people in Africa, compared to more than 100 in most other regions of the world. A recent study by KPMG [6] stated that 40%-70% users across Indian states want relevant content in local languages. Hence, connectivity alone will not bridge the digital divide — several major connectivity initiatives have failed due to:

(1) Lack of mobile platforms for localised content generation and distribution.
(2) The current mobile web content being very poorly designed and not optimised for low-end mobile devices.
(3) Lack of sustainable bottom up content-ad ecosystems — today's models are top down, highly centralised and controlled.

GAIUS aims to create decentralised sustainable highly localised light weight mobile web ecosystems for the next 3 billion users. The platform includes an innovative hyper-local browser that enables hyper-local communities in emerging markets to create, interact and monetise local content relevant to their communities in their own languages. GAIUS removes the dependency of communities to access the World Wide Web (WWW), empowering them to create their own hyper-local content ecosystems in a sustainable way. GAIUS empowers users in hyper-local communities to create, interact, transact and monetize a broad spectra of locally relevant content (community-specific content, business offers, news, jobs, ads, etc.) in their own preferred languages across a unified platform.

2 TECHNICAL INNOVATIONS

The GAIUS platform has three key technical innovations: **An edge application ecosystem:** consisting of lightweight content verticals in the form of channels. In addition to a highly simplified and optimised mobile client created using a new mobile app language called MAML (Mobile Application Markup Language) enabling:

- Creation and access to hyper local content.
- Easy creation and distribution using just a mobile phone.
- Allowing major content providers to reach previously untapped communities.
- MAML pages have the same look and feel of traditional mobile pages but are extremely lightweight and download much faster (Figure 1).

Rendering of HTML is a time consuming process and involves complex steps of downloading index.html followed by DNS resolutions, redirects and embedding of CSS and Javascript in a object dependency tree. MAML simplifies the process by supporting six different types of object: *image,text,video,rectangle,text-field, and button* which primarily helps to retain look, feel and functionality of HTML page. Each object is responsible for a specific set of tasks having defined attributes which drastically reduces page size and load time. For example, a MAML video object, corresponds to a HTML video tag having the following attributes: URL, x and y coordinates, width and height of the video frame. We have conducted a user study using Amazon mechanical turk, where we selected 25 users and asked them to give their opinion on a number of questions. The questions were organized in two categories: how do the MAML pages feel and do they look like fully functioning pages, and how similar are the MAML pages when compared side-by-side with their counter HTML pages. Figure 1 show that about 80% of the users confirmed that the MAML web pages feel and looks very similar to regular HTML pages.

Figure 1: Example MAML page of cnn.com

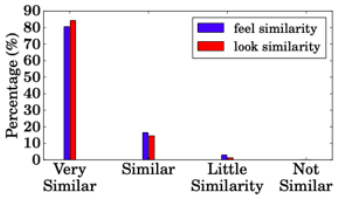

Figure 2: User experience: Majority of the users felt the MAML pages were very similar to traditional mobile pages.

A decentralised content-ad exchange: running at the edge:

- Decouples ads from content and moves the ad-bidding exchange to the edge.

- Offers a flexible and targeted ad delivery engine based on content provider policies, user preferences, network characteristics and locality of interest.
- Enables bottom up participation of local small, medium and large businesses in the local mobile content ad market.

A high performance mobile networking stack and an optimised content diffusion engine: providing an order of magnitude performance gains on mobile networks compared to current state of the art. We translated 25 popular web pages from Alexa's [4] top 100 sites from different developing countries. We hosted these pages at a GAIUS edge server and using the WebPagetest web performance tool [3] we compare the performance against two mobile browsers: Opera mini [2] and Google Chrome [1]. Our setup consisted of a Samsung Galaxy S4 Android phone, connected to our WebPagetest hosting machine. We requested each of the selected pages 18 times. For the GAIUS experiments, we requested the pages with three different fidelity levels (high, medium, and low) to simulate different network conditions and user preferences. Low fidelity represents a user with poor connectivity, while high fidelity represents a user with good connectivity.

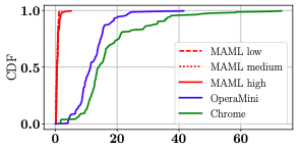

Figure 3: PLT CDFs (in ms): MAML pages vs mobile pages served via Opera mini & Chrome

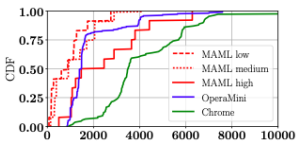

Figure 4: Pages Size CDFs (in kB): MAML pages vs mobile pages served via Opera mini & Chrome

Figure 3 shows the CDF of the page load times (PLT) for all three browsers. We can observe that Chrome has the highest PLT compared to Opera mini and GAIUS. Opera mini had a lower PLT because it requests the pages through dedicated servers that collect all of the necessary resources of the page, optimizes, and compresses the page before sending it to the client. In contrast, GAIUS already hosts the MAML representation of the pages on an edge server that is relatively close to the client, which enhances the PLT several-fold. The second important metric that we compare is the overall page size. The size of a page is critical in developing contexts because many people are constrained by a pay-as-you-go data subscription model, or they have relatively small data plans. Thus, being able to optimize and reduce the page size would significantly reduce their data consumption and browsing cost. Figure 4 shows the page size CDFs comparisons for all three browsers. We can observe that Chrome has the largest page size among the three browsers. This is unsurprising given that Chrome does not do any optimizations that reduce the page size. If we compare Opera mini to GAIUS MAML's high fidelity, we can see that in 50% of the cases, GAIUS serves slightly smaller pages compared to Opera mini. However, for the remaining 50%, Opera mini does perform better in terms of page size. If GAIUS operates at lower fidelity settings (dotted and dashed red curves), we can observe that in comparison to Opera mini, GAIUS reduces the median page size by 57% and 35% at the low and medium fidelity levels, respectively.

3 DEMO

The demo of the GAIUS platform would revolve around showcasing the above described technical innovations. The demo would consist of a mobile app using a low-end mobile phone, to highlight the benefits of GAIUS when used by users in emerging markets. The reason why we chose a low-end phone was due to the fact that GAIUS is built for users in emerging markets that can not afford high-end smart phones. However, due to the technical innovations of GAUIS we demonstrate that users can easily browse content quickly without incuring high delays and data costs. The demo would revolve around four main phases.

- **Content creation**: in here we will showcase the easy content creation feature of GAIUS, allowing users to generate their own content within a couple of clicks. We will demonstrate how users can easily create mobile pages from within the mobile phone. And with a press of a button the page will instantly be hosted within the platform, as well as be converted into the three fidelity levels.
- **Content promotion and advertisements**: this phase will highlight the simplicity of the bottom-up approach of content promotion and advertisements (ADs) submissions. Any user is able to create and submit an AD into the ecosystem and will highlight how the AD is going to be mixed within the existing GAIUS content.
  As mentioned above, the decentralised content/ad exchange engine, brings content promotion and ad exchange to the edge. GAIUS enforces a protocol for an initial rating of submitted ads based on *popularity, recent, effectiveness of content within a channel, richness.* A final rating is providing based on the initial rating combined with function of utility of the ad and budget of the content provider or user. Based on the final rating, a complex implementation of Vickery Auction is performed whenever ads are requested. This enables bidder to provide true value for their ads and also ensures relevancy of ad to the content.
- **Community creation**: this phase revolves around community creation. We will show how a regular user can easily create a community either publicly or privately. Additionally, we will show how the user is capable of inviting different members to that community.
- **Content curation with AI**: in this phase we will demonstrate the automatic content curation engine. We will showcase how this can be leveraged to easily curate content from the web directly into the above created community based on keywords provided.
  Content curation at GAIUS employs an intelligent way of collating and curating news and content based on the following factors: *freshness and relevance.* Cosine Similarity between keywords is applied to collate all content and then intelligently curated with help of tokenization and summarization of the content using NLTK tools.

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