

The Mobile Web in Developing Countries

Ravi Jain

ravijain@google.com

Abstract

The mobile web in developing countries has received increasing attention within the last few years, both as a potential means of bridging the digital divide as well as a lucrative market opportunity. However, while the realized gains so far as well as the potential are indeed tremendous, significant challenges remain to be overcome. Mobile data usage, particularly for advanced data applications, faces difficulties that are different from those posed by the initial expansion of voice services. The needs and environments of developing countries are very diverse, with as many significant differences perhaps as similarities, making it difficult to replicate country-specific solutions. In addition, while one traditional migration route of functionality – from the desktop to the handheld – may be viable in the industrialized world, it is not clear that this is the likely best approach in developing countries. What does seem clear is that there is a definite and significant need for further research examining the characteristics and challenges of the mobile web in developing countries at all layers, ranging from applications to networking. We sketch examples of such research issues, and mention specific roles the W3C could potentially play. This brief position paper presents these hypotheses with the goal of stimulating discussion at the workshop.

1 Introduction

The explosive growth of mobile phones and mobile voice services in developing countries has led to increasing attention towards the mobile web in those countries. Indeed, there are indicators that data usage is rising rapidly, and will continue to do so. Taking just India as an example, data revenues for the Indian carrier Bharti Airtel have gone from 4% of the monthly average revenue per user (ARPU) in Oct-Dec 2003 to 10% for the year ended Sep 2006 [Bhar06], and increases in the proportion of data revenues are seen for other developing country carriers also. Some estimates place the cumulative annual growth rate of the mobile data market in India to be as high as 77% through 2010 [Leh05]. Although SMS accounts for a large portion of the data usage, revenues from non-SMS services, such as downloads of ringtones and news, have also been growing. Again using Bharti as an example, non-SMS data revenues contributed 4% of total revenues for 2006 [Bhar06].

There are several well-known factors contributing to the growth of mobile data, as well as projections of future growth, such as the low penetration of fixed telephone lines as well as PCs and Internet access. Carriers in many developing countries, like their counterparts in many industrialized countries, face declining ARPU. For example, Bharti experienced an 8% decline in ARPU for the year ended Sep 2006, despite a 16% increase in average minutes of use per user [Bhar06]. For the carrier MTN Nigeria, ARPU declined almost 20% between 2004 and 2005 [MTN06]. This has led to carriers having increasing interest in making up the decline by stimulating data usage, for example by increased marketing, attractive data pricing and reduced handset prices. It is likely that these efforts will bear fruit and data usage will increase both for SMS and non-SMS services.

Nonetheless, there remain several well-known challenges unique to mobile web usage in developing countries. The outline of the rest of this paper is as follows. In the following section we first outline some of the challenges facing the mobile web in developing countries. In section 3 we discuss a model of migration of web usage and its difficulties for developing countries. In section 4 we discuss the need for further research and outline specific examples at different technical layers, and finally we end with a brief summary.

2 Challenges for the mobile web in developing countries

As mentioned above there are several challenges for the mobile web in developing countries. Aside from the basic issues of cost, connectivity and coverage, there are issues of usability by the end users that are different from those faced for the initial expansion of voice services. Generally low levels of literacy mean that relying on text alone as a

medium is unlikely to succeed for significant parts of the population. The diversity of users within developing countries, even those with relatively small populations, is often significantly greater than in industrialized countries, with differences in language as well as marked regional and cultural attributes. This complicates the generation of locally useful content, which already faces challenges in terms of fundamental technical issues such as character encoding (see, for example, [Ping06]), as well as issues of bootstrapping and gaining critical mass.

The issue of content and language is particularly interesting. A study by the World Information Access (WIA) Project at University of Washington has found that in Latin America and Asia, people are putting more cultural content online than into books, with new websites going up at five times the publication rate of new books [WIA06]. However, a very large proportion of the content worldwide, as well as in developing countries, is in English, which obviously limits access; experts estimate at most 20% of the world speaks English, and the percentage in developing countries is obviously generally much less. This has consequences for the other aspect of the mobile web, namely its potential for reducing the digital divide. The WIA study found that people in developing countries spend a greater proportion of their income on fixed Internet access than those in industrialized countries, but are likely to find much less locally-significant content. It is not clear whether or how this carries over for the mobile web, but if the mobile web paradigm were to be one of simply providing access to the WWW at large, it would be problematic.

In this context it bears repeating that developing countries are not a monolithic entity, in terms of general economic attributes as well as specific market attributes. While there are some broad similarities compared to industrialized countries (lower literacy rates, lower per capita incomes, and other gross metrics) obviously there are numerous differences. As one example, a study commissioned by the GSM Association found that India and Philippines, while having per-capita incomes in the same general range (\$641 and \$1041, respectively, compared to about \$43,000 for the US), have significantly different GSM coverage (60% and 99% of the population, respectively) and GSM penetration (11% and 40%, respectively) [GSMA06]; see Figure 1. On the other hand, while Uganda has a significantly lower per-capita income than India (\$250 in 2004), it has much greater coverage (96% of the population), but GSM penetration in the same general range (6%).

Obviously a great number of factors influence mobile penetration, ranging from population density and terrain to competition, regulation and the attributes of the fixed network. Even more factors come into play to influence mobile web usage, as mentioned previously; these include population demographics, affordability and transparency of data pricing plans, literacy, government censorship policies, and so on. The net result is that while there are a few, large broad-based success stories for mobile data, like SMS, many other data services have not enjoyed the same success (MMS being a case in point), and replicating any country-specific success is likely to be difficult.

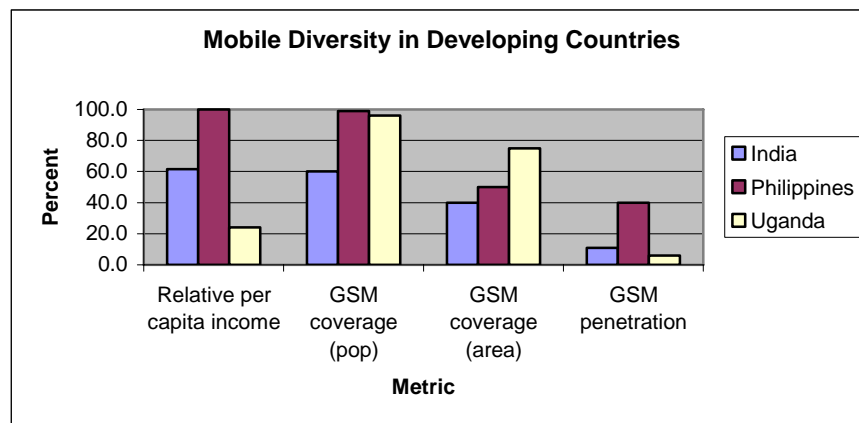


Figure 1: Mobile diversity in developing countries. (Source: [GSMA06], [WDI06] for Uganda PCI).

3 A model for emergence of advanced mobile applications in developing countries

We consider how advanced mobile data applications would emerge and develop in developing countries. For the sake of discussion, we loosely define an “advanced data application” as one that is not telephony-oriented (e.g.

VoIP) and is not in wide usage at present (e.g. SMS, ringtone download). Thus examples would include MMS, search, mail, online calendar, video, games, social networking, and maps.

To place some structure on the discussion, we divide the space into quadrants as in the model shown in Figure 2. While the model contains many generalizations and individual features are arguable, it can be used to highlight some issues.

With this model, there are two ways that an application that resides in a particular quadrant emerges. It can be “natively” created for that quadrant, or it migrates there from some other quadrant. Thus in industrialized countries, some advanced mobile data applications have been developed natively, i.e., largely with the mobile web in mind, such as real-time road traffic updates with map displays. On the other hand, many have emerged as a result of migration from the fixed web. Applications such as search, mail, and maps certainly seem to reflect this latter trajectory. Consider migration delay to be the time from the adoption of an application on one quadrant to comparable adoption on the other quadrant, where “adoption” is taken to mean “percentage of those with Internet access on the relevant terminal device who use a particular application”. Clearly there is a migration delay in this trajectory, but the trajectory does exist.

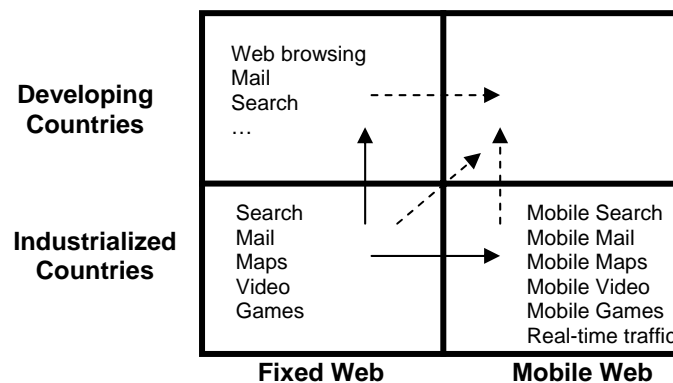


Figure 2: A simplified model for emergence of advanced mobile data applications in developing countries

For developing countries, while there are applications that have been natively developed for the fixed web, many applications are a result of migration from fixed web applications in industrialized countries. Applications such as search, online calendar, and video seem to follow this trajectory, the migration delay being a result of factors such as lack of broadband availability, relatively expensive data pricing, lack of proliferation of multimedia PCs, etc.

Now consider our target, the top right quadrant, consisting of mobile applications in developing countries. There are indeed mobile applications that have been developed natively or have reached greatest popularity in this quadrant. An example is TV game-show voting via SMS, with the exemplar perhaps being the show KBC in India, which has generated an average of 700K SMS messages per day on Bharti Airtel [Leh05]. However, if we exclude SMS-based applications the penetration rate drops rapidly.

That leaves three obvious migration paths to the top right quadrant with this model. The diagonal path to this quadrant from a fixed web application popular in an industrialized country seems to have many inherent difficulties. Migration from the fixed web in developing countries seems problematic since in fact the penetration of the fixed web may be lower than that of the mobile web. Finally migration of advanced mobile data applications from industrialized countries to developing countries is also not straightforward, due not only to technological factors (lack of wireless broadband, relatively expensive data pricing, lack of multimedia and advanced handsets, and so on) but the other factors sketched in sec. 2, such as diversity of language, region, culture, income, affordability and a host of other factors. Thus even if migration were to occur, the migration delay may be large, and relying on migration alone may not be the best strategy; developing applications specifically for this quadrant needs to be considered.

This analysis is not to say that the prospects for advanced data applications in developing countries are bleak – far from it. Instead, it points to an imperative to understand local needs, usage, constraints and opportunities in much greater depth so as to target applications most directly.

4 Further research

Developing an understanding of local needs, usage and constraints directly leads to the need for further research on underlying phenomena and technical issues. It is obvious that the quantity, breadth and depth of research on the mobile web for developing countries are all much less than that for any of the other quadrants in our model.

It also appears that in fact research is needed at many levels of the technical stack, ranging from applications to networking. In this section we briefly sketch individual examples of existing research or developments that shed light on the research questions that need to be addressed.

Applications. It is interesting to consider one example of an application that can migrate from the fixed web in developing countries to the mobile web. Kiva is a non-profit organization based in the US that has taken a novel approach to microfinance in developing countries in that it allows individual lenders to make small loans to specific micro-enterprises via its website [Kiva06]. Lenders read short descriptions about would-be borrowers on the website, pick an enterprise to support, and make a loan (typically of the order US\$100) using their credit card. Kiva transfers the funds to its local partners, which are organizations in the developing countries that have located and vetted the borrowers. Over time the local partner collects the loan repayments and the funds are returned to the lender for possible re-lending.

To facilitate and speed up this entire process, Kiva has experimented with using mobile phones, in particular to collect photographs and descriptions of the borrower's micro-enterprises and send them to Kiva via MMS. This has been very effective and welcomed by the local partners. However, we can envision several practical difficulties, such as the cost of MMS, bandwidth and connectivity concerns, the cost of the handset, and so on. In addition it would be highly desirable to avoid having to type any text at all, but to send audio descriptions and also provide automatic tagging of images (location and other context) as records of the enterprise's progress are generated. These issues, even with a relatively well-understood service like MMS, point to the need for investigation to develop further innovative applications and make them more seamless as well as portable across networks and countries. Standardization efforts, such as those led by the W3C, may be helpful in this regard.

Network studies. The architecting and design of applications and systems rests on understanding the dynamics of the user and network behavior. Where resources are scarce and technical challenges are more severe, as in developing countries, this is all the more important; however, it is precisely in these situations that information is most lacking.

One study of WWW traffic in Cambodia and Ghana reveals, for example, not only the specific characteristics of the traffic, but that current web applications are ill-suited for the low bandwidth environment found in those countries. Further, well-known solutions such as caching, compression and proxying can lead to a significant improvement in performance and user experience [Du06]. There is a need to conduct further such studies, and one possible role for the W3C is to help bootstrap the collection and central storage of mobile web data traces for developing countries for use by researchers worldwide. A possible model for this is the archive of wireless traces being developed by the CRAWDAD project at Dartmouth College [CRAW06], but with global scope and oriented towards stimulating collection of data in environments and regions that are under-represented.

Security. The explosion of mobile communication worldwide has prompted concerns about security, but much remains to be done. One area of vulnerability that is probably particularly relevant to developing countries is that of SMS security. For example, a recent study shows that SMS networks have vulnerabilities which have not been sufficiently addressed [Tray06]. Given the sheer volume of SMS messages in developing countries (over 1 billion messages/month in India alone [Leh05]) and their increasing usage for transactions (such as train ticket reservation in India) it seems to be only a matter of time before any loopholes are exploited. Needless to say, further security investigations would likely reveal other vulnerabilities. Best practices efforts, such as those led by the W3C Mobile Web Initiative, may be helpful in this regard.

5 Summary

We briefly summarize the motivation and challenges facing the mobile web in developing countries, and analyze possible paths for the emergence of advanced mobile data applications using a simple model of application development and migration. The needs and environments of developing countries are very diverse, and the route of migrating functionality from the desktop to the handheld may not be the best approach in developing countries.

It is clear that further research is needed to get a deeper and broader understanding of fundamental needs, characteristics, usage and constraints of the mobile web in developing countries. We sketch three examples where there is ongoing research work and more is needed: novel applications such as facilitation of microlending via advanced MMS and tagging; studies of network and user dynamics with a view to stimulating collection, archival and dissemination of detailed traces from under-represented regions and environments; and analysis of security threats that may be particularly important for developing regions. In addition to standardization and best-practices efforts in general it appears there may be a special role for the W3C to play in terms of leveraging its global reach and perspective to act as a catalyst for the mobile web in developing countries.

References

- [Bhar06] Bharti Airtel, *Quarterly Financial Report FY07, Operating Highlights*, Sep. 2006. <http://www.bhartiairtel.in/>
- [CRAW06] CRAWDAD: A Community Resource for Archiving Wireless Data At Dartmouth, 2006. <http://crawdada.cs.dartmouth.edu/>
- [Du06] Du, B., M. Demmer and E. Brewer, Analysis of WWW traffic in Cambodia and Ghana, *Proc. WWW 2006*, May 2006.
- [GSMA06] GSM Association. *Universal Access: How Mobile can Bring Communications to All*, GSM Association Universal Access Report, 2006. http://www.gsmworld.com/documents/universal_access_full_report.pdf
- [Kiva06] Kiva. <http://www.kiva.org>
- [Leh05] Bihani, S., A. Hellawell and D. Pow, *Mobile Data in India: Operator Margin Surprises to Accompany Solid Usage Growth*, Industry Analysis, Lehman Brothers, Oct 24, 2005. <http://www.lehman.com>
- [MTN06] MTN Group, *Interim results presentation for the six months ended 30 September 2005*, November, 24 2005. <http://www.mtn.com/>
- [Ping06] Pingali, P., J. Jagarlamudi, and V. Varma, WebKhoj: Indian Language IR from Multiple Character Encodings, *Proc. WWW 2006*, May 2006.
- [Tray06] Traynor, P., W. Enck, P. McDaniel and T. La Porta, Mitigating Attacks on Open Functionality in SMS-Capable Cellular Networks, *Proc. ACM Mobicom 2006*, Sep. 2006.
- [WIA06] Howard, Philip N, and World Information Access Project. *World Information Access Report - 2006*. Seattle: University of Washington, 2006. <http://www.wiareport.org/>
- [WDI06] World Bank, *World Development Indicators database*, April 2006. See <http://devdata.worldbank.org/external/CPProfile.asp?CCODE=UGA&PTYPE=CP>