Short Paper: BSense – A System for Enabling Automated Broadband Census

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ABSTRACT

Broadband Internet access is increasingly being looked at as the new *utility*, in the same way as water supply and electricity networks. Broadband networks are also being viewed as infrastructural assets, such has roads or highways, because of the strategic importance they carry in relation to economic growth. This new view is driving the need for policy makers and governments to get a better understanding of broadband coverage and quality, with a particular emphasis on identifying underserved areas.

We propose `BSense`, a broadband census system based on open-source software that attempts to utilize broadband data from different sources and enable an automated broadband census.

Categories and Subject Descriptors

C.2.5 [**Local and Wide-Area Networks**]: Access schemes; C.4 [**Performance of Systems**]: Modeling techniques; C.4 [**Performance of Systems**]: Measurement techniques

General Terms

Design, Performance, Measurement

1. INTRODUCTION

There exists a digital divide in terms of broadband Internet access in most countries across the world. The underlying reasons can be varied from location (remoteness, terrain) and population density to lack of infrastructure, deployment costs and socio-economic factors. The divide widens when it comes to developing regions. In India, for example, there are only 2.5 million broadband subscribers in a population of over a billion and only less than 10% use the Internet [1].

While the above figures, usually obtained via personal surveys, are useful for highlighting the existence of the broadband digital divide, they cannot completely and precisely quantify the problem. *Broadband census or mapping* is a term typically used to describe the latter exercise. Broadband census is considered important by all stake holders — consumers, Internet Service Providers (ISPs) and policy makers. This is evident from the plethora of consumer broadband tests available (e.g., [2, 3]), business models underlying companies like Epitiro [4], and recent initiatives by telecom regulators and governments in the UK, US and elsewhere [5, 6]. For the purposes of this paper, we use a modest definition of broadband as a form of Internet access that is always on and with better than dial-up speeds. It can be provided via any of the several broadband access technologies: wired (e.g., DSL, cable, fibre) or wireless (satellite or terrestrial).

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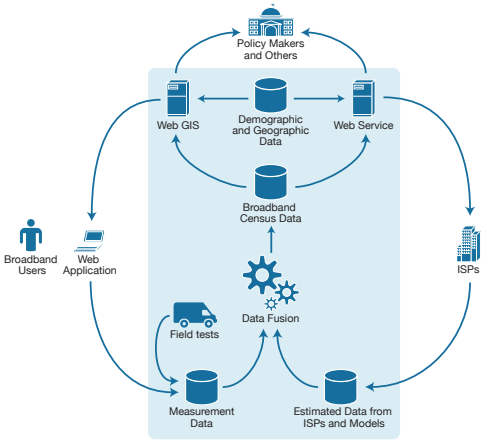
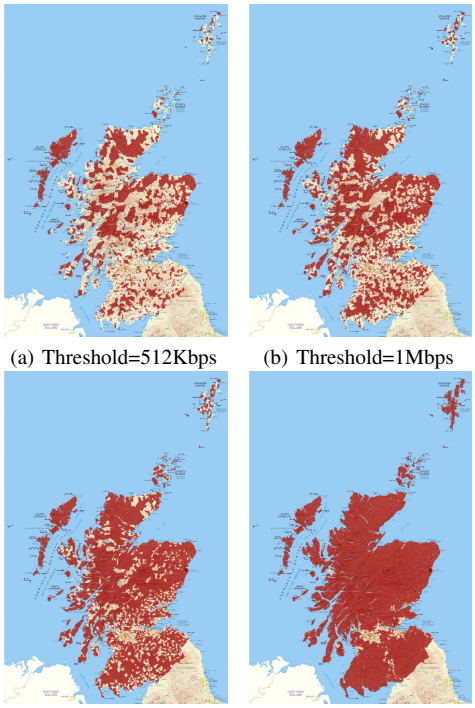


Figure 1: `BSense` broadband census life cycle.

Quantifying the broadband digital divide broadly requires study of three aspects: coverage, choice (cost) and quality. Studying coverage involves identifying "notspots", i.e., areas not serviced by even one broadband access technology. In order to determine the amount of choice that a consumer has, one needs to find out the number of access technologies and ISPs available at the consumer's location. Greater choice usually also implies lower cost (per Mbps) for the consumer. Broadband access quality is measured using a set of metrics such as download/upload speeds, latency, jitter and packet loss rate. In practice, these factors directly affect Internet applications, especially those requiring real-time traffic (e.g., voice and video). Note that all these three aspects of coverage, choice and quality vary with time. Existing broadband census approaches can be broadly classified into two categories: estimation-based and measurement-based, each having a set of pros and cons[1].

We develop a flexible software system based on open source

[1]For a longer discussion of existing approaches and details of the proposed `BSense` framework and implementation, see: G. Bernardi and M. K. Marina. *BSense: A System for Enabling Automated Broadband Census*. May 2010, Technical Report, `http://www.wimo.inf.ed.ac.uk/bsense/BSense-techreport.pdf`.



(a) Threshold=512Kbps (b) Threshold=1Mbps

(c) Threshold=4Mbps (d) Threshold=8Mbps

Figure 2: BSense generated map of notspots in Scotland that lack a service supporting download speed greater than the indicated threshold. Notspot postcode areas are shaded in red.

tools called BSense for enabling automated broadband census for any region. Our work differs from existing work on broadband census in several ways. First, our approach is to use a combination of estimated and measured data, whereas existing approaches use one or the other. Second, we provide a flexible implementation of our BSense broadband census system based on open source software, making it generally applicable and low cost to deploy anywhere. Finally, our framework offers incentives for all stakeholders to contribute to the creation of a complete and reliable broadband map.

2. THE BSENSE SYSTEM

Broadband census is needed by each of the various stakeholders — consumers, ISPs and policy makers. We believe that cooperation among different stakeholders is needed for a complete, reliable and evolving broadband map. Keeping this in mind, we present what we call a broadband census life cycle (see Fig. 1): consumers would benefit from comparing their observed broadband quality over time with their ISP's advertised service and they would be interested in knowing the broadband coverage and quality in their neighborhood. ISPs normally pay for market research information to determine the areas to upgrade their networks and improve their service quality. Finally, policy makers can query the broadband census system using an API to get a true picture of broadband coverage and quality and accordingly make informed policy decisions. BSense enables each stakeholder participating in the mapping effort to receive valuable information in return.

The BSense system integrates both estimated and measured broadband data and overlays it over demographic and geographic data to generate broadband maps as needed. A set of web services APIs can be used to feed the system with initial coverage estimations and broadband measurements. The information gathered is stored in a relational database enabled for spatial information storage and is then processed via a data fusion engine, which enables automated and evolving broadband census creation with the engine performing online model validation using measurement data. The engine component in the current implementation is very basic and its further development is a part of our future work. BSense output is made available via a diverse set of tools and protocols: textual data can be retrieved via SOAP API calls, raster and vectorial maps can be generated by invoking standard WMS (Web Map Service) and WFS (Web Feature Service) services, and a built-in web interface can be used interactively to browse and generate annotated map. Finally, the use of the WMS and WFS open standards enables third party GIS software products to readily interface with BSense.

2.1 Case Study: A Broadband Census for Scotland

We used the BSense system for creating a preliminary broadband census for Scotland. One source of our data is the *estimated* broadband data imported to our database (using the tools we developed) from public websites of the main ADSL provider, two cable providers and one of the 3G mobile telecom operators. To obtain broadband quality *measurement* test results from users, we developed a website[2] that first prompts the user for a valid postcode in Scotland, then asks four basic questions on access technology type, ISP name, advertised speeds for the service purchased by the user followed by a Java applet based test of the user's broadband connection using a modified version of the NDT software [2]. Through wide publicity of this test website after its launch on 30th March, 2010, we obtained more than 400 measurement test results.

An example of a simple fusion of estimated and measured data in BSense can be used to infer the "notspots" in Scotland. We define a postcode area as a notspot if neither the estimated data nor the measurement data in our database suggest a download speed greater than a specified threshold for four different threshold values (512Kbps, 1Mbps, 4Mbps, 8Mbps). Resulting notspot maps produced by BSense for these four threshold values is shown in Fig. 2. It can be clearly seen that most postcode areas outside of the central belt of Scotland become notspots as the threshold is raised.

3. CONCLUSIONS

We have a developed a flexible software broadband census system called BSense based on open source software. Though this work is still under active development, we showed the value of the BSense approach through a case study involving creation of a preliminary broadband census for Scotland. Our future work will focus on enhancing the capabilities of the data fusion engine in BSense as well as a detailed investigation of measurement techniques from a broadband mapping viewpoint.

4. REFERENCES

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