BROADBAND DEMAND AGGREGATION: PLANNING BROADBAND IN RURAL NORTHERN CALIFORNIA

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ABSTRACT

Using GIS tools we examine opportunities to provide broadband service to residents of four rural counties in northern California, Del Norte, Humboldt, Mendocino and Trinity Counties. The project combines community and business demand via quantitative and qualitative, survey-based data in conjunction with characterization and mapping of the existing broadband infrastructure (that either serves or runs through this region). This process explores a variety of broadband delivery options (DSL, cable, wireless, etc.) in context of the physical and environmental challenges of the rural north coast of California. This presentation includes a discussion of the steps to develop alternative scenarios (technology, construction and connections) for building broadband infrastructures that meet the adopted criteria and take into account potential interfaces with broadband infrastructure in adjacent counties. Furthermore, we outline a process for selecting a recommended alternative for broadband service in each community based on infrastructure and demand considerations.

INTRODUCTION

As broadband Internet connectivity has spread over the last decade, its availability has provided a wide array of new capabilities to government, business and individuals. However, in many areas, and particularly rural regions this is not the case. A variety of factors contribute to this limited access to broadband. Costs to install and maintain broadband infrastructure are relatively high so for some providers it is simply not an option. In the fall of 2006 an initiative entitled Redwood Coast Connect (RCC) was launched to examine market demand, availability and infrastructure issues related to broadband access and availability in rural northern California. The geographic focus includes Del Norte, Trinity, Humboldt and Mendocino counties (Figure 1). These four counties form a well-defined natural region, blessed with world-class natural wonders and sharing a remote and isolated rural geography.

Figure 1: Redwood Coast Connect study area including the northern California counties of Del Norte, Humboldt, Mendocino and Trinity.

The Redwood Coast Connect (RCC) initiative is supported by funding from the California Emerging Technology Fund in partnership with the Humboldt

Area Foundation (HAF), the Northern California SBDC Network, Humboldt State University (HSU) and Redwood Coast Rural Action (RCRA). An important aspect of the project was the recognition that successful broadband deployment requires more than just assuring requisite infrastructure is available. In order to ensure a comprehensive and successful deployment, five issues must be considered: Access, Applications, Affordability, Accessibility and Assistance.

The long-term goal of the project is to make available ubiquitous broadband to all rural communities in the region through the aggregation of users, engagement of providers, simplification of county and municipal policies and tapping the ingenuity of entrepreneurs in the region. The first phase which is a planning phase will set the strategies, actions and desired specific outcomes that will help define the next step of implementation. The planning process involved a multi-pronged approach including a series of community meetings with businesses and community members throughout the RCC region. Written, phone and online surveys of current and potential business and residential customers were conducted to develop an understanding of the demand for broadband (RCC website). Survey data was geocoded to the address of the current or desired broadband access and combined with a variety of physical, infrastructure and environmental data to develop a better understanding of both current broadband availability and the potential for extending access to areas with unmet demand.

The California Broadband Demand Aggregation Pilot Project will develop and demonstrate a model that can be used as a template to increase broadband for all of California's rural regions. This planning phase will provide a benchmark of current regional readiness to participate in the changes that high-speed communications entail. Such readiness assessment is critical to addressing a viable plan for broadband deployment. This project will have a positive impact on the entire region by demonstrating business scenarios for broadband infrastructure investment. Increased broadband accessibility will increase California Broadband Demand Aggregation Pilot Project opportunities for business development, jobs, and access to quality health care and educational opportunities.

This paper addresses geospatial analysis components of the RCC study managed by the Institute for Spatial Analysis (ISA) at Humboldt State University. The ISA serves as a focal point for the advancement of spatial research, innovation and application. The ISA is dedicated to the expansion of spatial analysis methodologies across disciplines and the full spectrum of real world issues. We work closely with the public and private sector entities to achieve this goal. The facility serves as the focal point for graduate and faculty from across campus to effectively utilize geographic information systems and image processing technologies in a wide variety of projects and research (ISA website).

MATERIALS AND METHODS

Analysis of the geospatial data was completed by the Institute for Spatial Analysis using ArcGIS 9.2 (ESRI). Scenario modeling was developed with CommunityViz Professional 3.1 (Placeways). Publically available interactive maps are served using ArcGIS Server 9.2 implemented on an ArcGIS Server platform (Inline Corporation).

Geospatial data was acquired from a variety of sources including commercially available telecommunications data (TeleAtlas), as well as a wide array of publically available data from Federal, State, County and local sources. Where additional, detailed data was required, we worked directly with broadband providers to develop maps of their coverage areas. Survey data included street address information and responses were geocoded to allow for accurate mapping of demand.

A first step in the GIS analysis was to acquire and evaluate available data. We acquired over 500 geospatial data sets covering the four county study area at the state, county and municipality levels. After review, layers containing similar information were merged into a single data layer. For example, broadband footprints by provider were combined into a single broadband access footprint layer (Figure 2). After evaluation and aggregation of data and creation of additional data layers from survey information, hand digitizing and data extraction from other hard-copy and digital sources that had not been provided in geo-referenced formats we reduced the data to approximately 200 geospatial data layers. Over 100 of these were compiled into a comprehensive geodatabase to be accessed via the ArcGIS Server online mapping system.

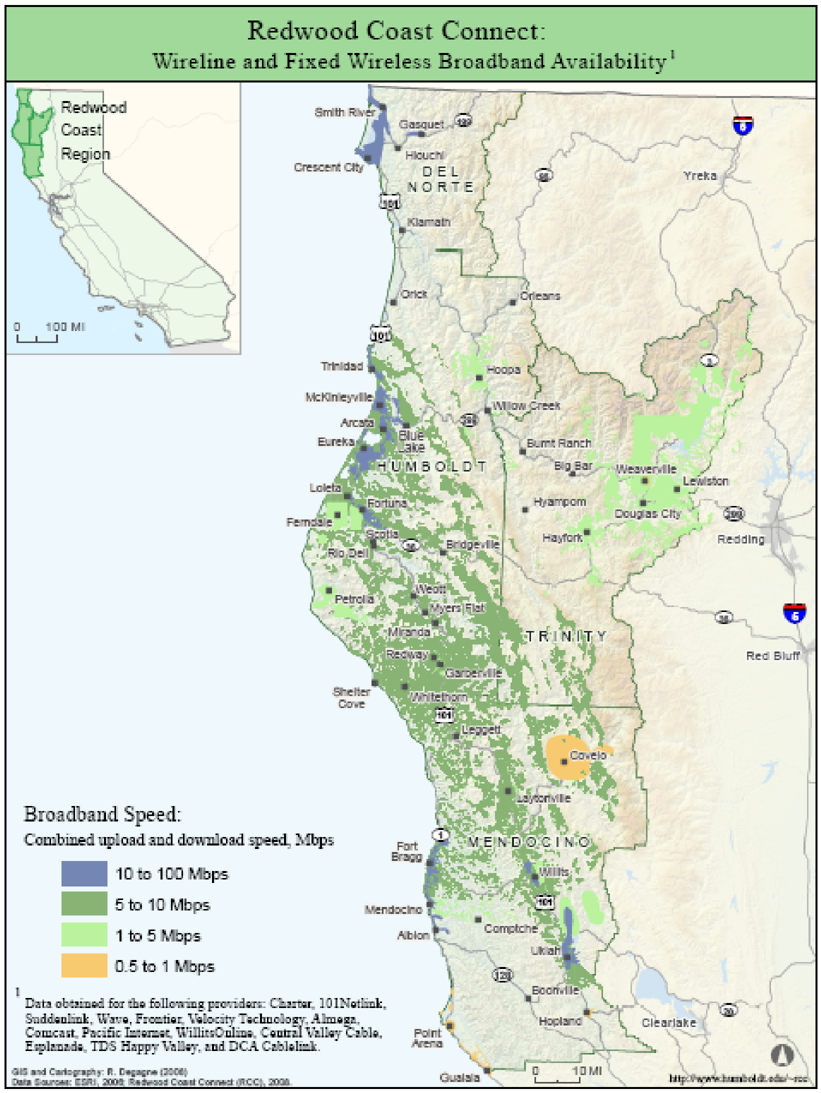

Figure 2: Broadband availability footprint for the RCC study region.

One of the more challenging aspects of obtaining accurate broadband coverage footprints was the variety of forms in which data was, or was not available. Some providers were unwilling to share detailed coverage information for competitive reasons. In these cases we were limited to coarse resolution (3 km raster data) provided by the California Emerging Technology Fund. In other cases we were provided standard road maps with highlighted coverage areas which we were required to hand digitize and georeference. For some of the fixed wireless providers we were provided tower locations and transmitter specifications which allowed us to model coverage footprints using viewshed analysis tools in ArcGIS in conjunction with elevation data from the national elevation data (NED) at 10m resolution. In a few cases, providers were willing and able to provide coverage footprints in GIS compatible formats.

Because there are relatively low population densities in rural regions and large tracts of public land, it is not appropriate to assume housing or demand is equally distributed in census blocks (Figure 3). Unfortunately, parcel information was not available in digital form for the entire study region so we could not reliably determine which parcels were zoned residential. We modeled housing as a surrogate for actual parcel data. To ensure populations were allocated only to areas that were appropriate, housing units were allocated only on private lands (excluding the substantial areas of State and Federal public lands in the study region) and within a reasonable distance of roads based on average distances observed.

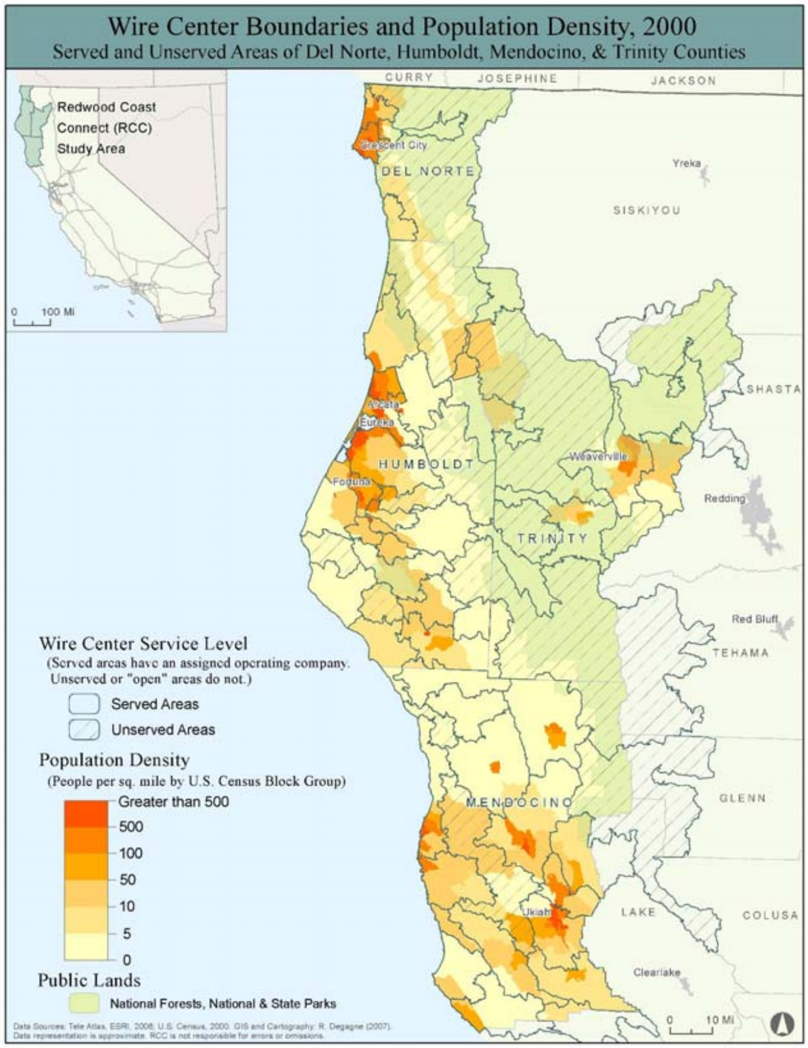

Figure 3: Population density in the RCC region as represented by the US Census (2000) overlaid by wire center service areas.

RESULTS

Our objectives to develop available coverage maps as well as to generate demand areas from geocoded survey data were met. This data is now being used by telecommunications consultants and policy-makers to move forward in the next phase of RCC's work. Two specific products developed by the Institute for Spatial Analysis to support the development of demand scenarios are notable. First an online mapping tool which provides the telecommunications consultants for the RCC project with access to over 100 geospatial data layers via an ArcGIS Server interactive map (Figure 4). This map tool provides detailed information about demand location, willingness to pay, and a variety of other important factors derived from the georeferenced survey data and other geospatial data sources acquired and developed through this project. It was essential that project data be available via a web-based interface since project consultants were located as far away as Oregon and Southern California. The ArcGIS Server permitted the project consultants to explore and interact with the geospatial data while working together from multiple locations within and outside of the RCC study region.

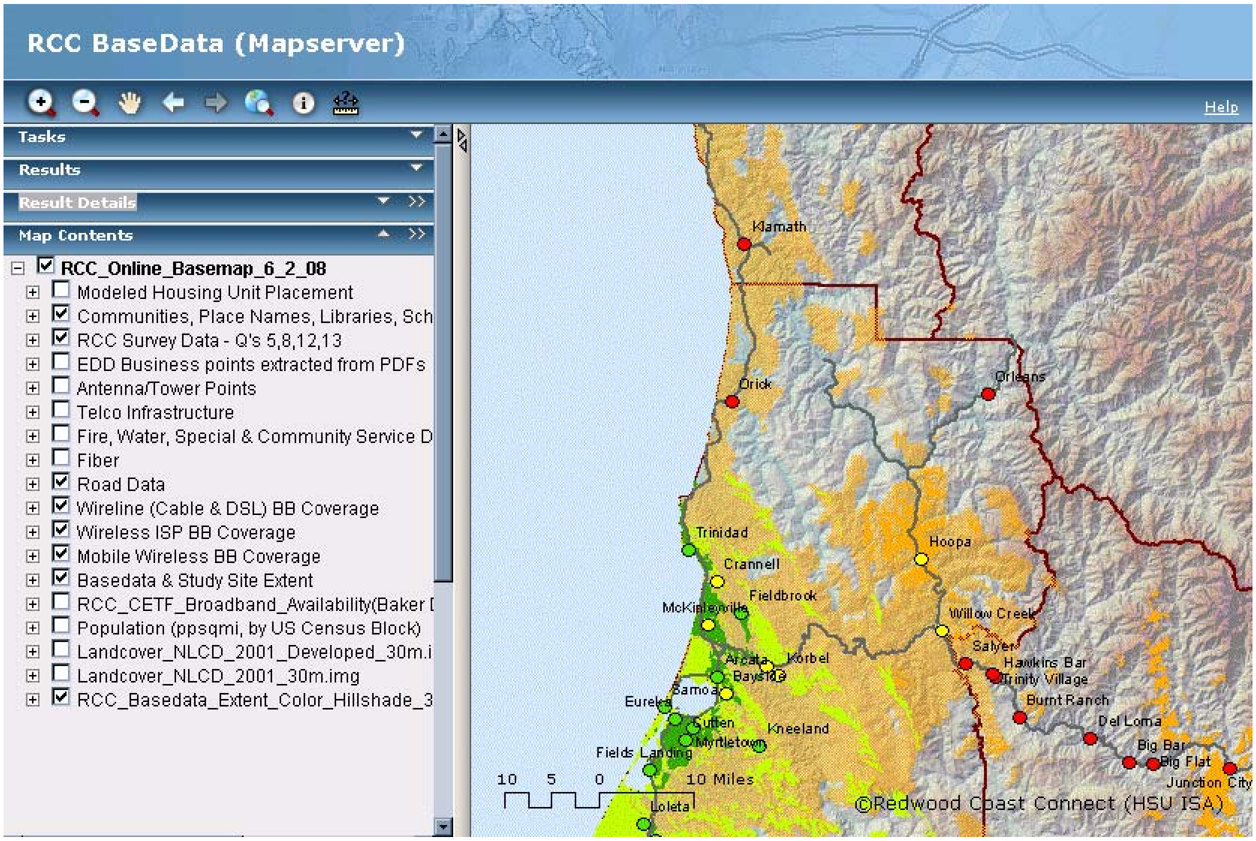

Figure 4: The ArcGIS Server interface developed for use by RCC project consultants. This tool makes over 100 layers of information available to project consultants for analysis via a web-based interface. Because consultants to the project are located as far away as Oregon and Southern California, it was essential that they be able to interact with the geospatial data remotely.

To facilitate exploration of various scenarios for extending broadband coverage, we developed an interactive modeling tool using the CommunityViz 3.1 software extension for ArcGIS. This tool permitted us to provide tools allowing a user to set parameters based on distance to extend coverage, number of new customers desired (including capture rates for anticipated subscriptions) as well as costs per mile to extend the infrastructure (Figure 5). These tools allow interactive mapping based on the data and parameter settings. As the user alters values in the system, the ArcGIS map display is updated to show the households that would be captured under a given scenario.

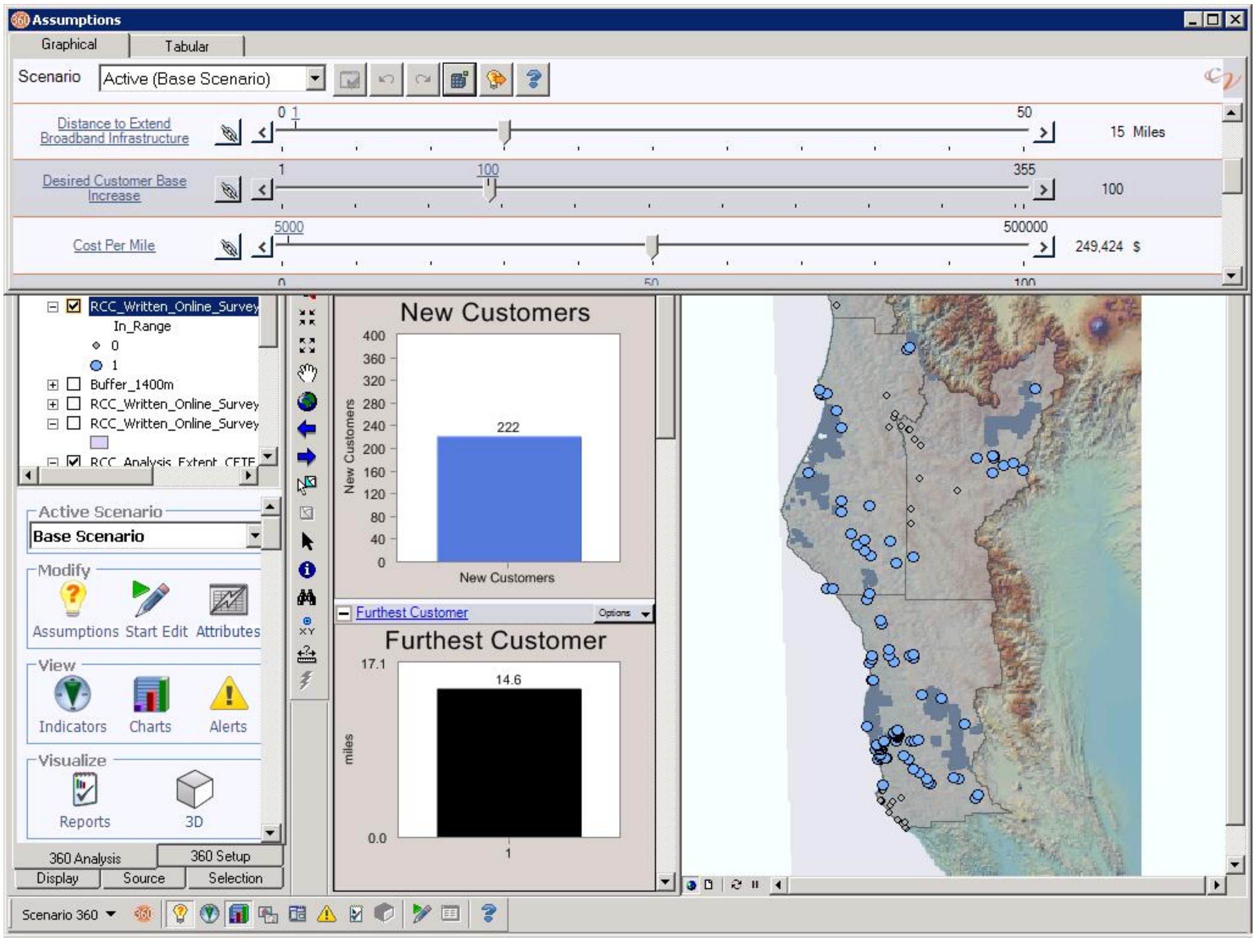

Figure 5: The CommunityViz scenario modeling interface. Slider bars such as those shown at the top of the figure permit a user to alter the values for a variety of parameters. The number of new customers and distance to the furthest new customer are dynamically updated and highlighted on the map and in bar graphs shown in the ArcGIS interface.

DISCUSSION

It is clear that rural communities desire and would benefit from greater access to broadband services such as are available in the more urbanized and suburban areas of California. The most significant hurdles to achieving the goal of ubiquitous broadband include limited numbers of businesses and households which are sometimes perceived as insufficient to justify the cost of extending broadband services to these regions. Our preliminary work shows that the demand may be substantially higher than previously believed and access, even in the larger communities is often substantially lower.

Fixed wireless broadband provided locally appears to be one means for extending broadband service more widely. However, rugged topography and vegetation limit the extent any single transmitter can effectively cover. More importantly however, is the backhaul capacity to connect providers to the Internet. Through continued research, and by exploration of new methods of providing service to rural communities, it is be possible to provide reliable internet to the citizens of rural California.

REFERENCES

Redwood Coast Connect, http://redwoodcoastconnect.humboldt.edu *Website accessed June 2008.*

Humboldt State University, Institute for Spatial Analysis, http://www.humboldt.edu/~isa/ *Website accessed June 2008.*

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