Esri Position Paper – 2013 CyberGIS '13 All Hands Meeting[1]

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We understand the term "cyberGIS" essentially to mean GIS detached from the desktop and deployed on the web, with the associated issues of hardware software, data storage, digital networks, people, training and education. This deployment may involve an individual, isolated server, a broader enterprise scenario including connection to a universe of mobile devices, or an even more pervasive deployment in the cloud. With the advent of cloud computing coupled with web mapping as a new platform for GIS, there is an opportunity to reinvent GIS applications, as well as to extend the discovery and availability of spatial data and geospatial analyses. Cloud computing provides the potential for access to and publication of dynamic data, as well as the consumption of real-time information for analyses and modeling.

Although still to be proven conclusively in all possible use cases, the potential of clouds, with their rich collection of software modules, APIs, general- and special-purpose computation, and data storage, is extremely promising as an infrastructure for cyberGIS, and ultimately for e-science. We argue therefore, that in order to best to achieve effective sharing and collaboration of data, users, and communities, one must also seek to understand the advantages and limitations of cloud computing in the context of spatial computation. In other words, cloud computing (and hence cloud GIS) needs to always be in the conversation when discussing CyberGIS.

Cloud GIS allows one to use GIS over the web without the cost and complexity of buying and managing the underlying hardware, software, and/or web server capabilities. In principle, it is always on, always available, and provides state-of-the-art functions that are supposed to be highly reliable and flexible enough to handle large volumes of Internet traffic. Further, there is the notion of an "intelligent web map," a medium by which to integrate multiple map services, data services, and analytical model services together, and to embed them in a browser or a web site, share them on a mobile device, or integrate them into social media. Such services support editing, pop-up windows, time-enabled slider functions, and the building of additional analytics and workflows so that changes made to the original data, to the analytic model dependent on the data, and to the properties of cartographic map layers, are immediately updated on the web map, in near-real time.

Further, we posit that cyberGIS should provide for the user as a fundamental component an environment in which to perform and evaluate a wide array of spatial analyses in a "community playground" of datasets, maps, scripts, web-based geoprocessing services, and GIS analysis models. The "playground" may be in the context of an *Intranet* within organizations (e.g., private clouds, including **virtual organizations**), as well as the broader Internet (public clouds). with a low barrier to entry, a cloud-hosted environment for users to leverage as a platform for sharing, communication, and collaboration is achievable, and currently available in a variety of forms.

Using the example of ArcGIS Online or AGOL (http://arcgis.com/) latest developments include:

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[1] This position papers follows on heavily from Wright, D.J., Kouyoumjian, V., and Kopp, S. Towards a community "playground:" Connecting cyberGIS with its communities, in Wang, S. and Goodchild, M.F. (eds.), *CyberGIS: Fostering a New Wave of Geospatial Discovery and Innovation*, New York: Springer, in press, 2013.

- **Explosion of content**: Content includes basemaps, web maps, imagery, demographics, and boundaries, much of which is exposed via pop-ups and infographics. The past year has also seen the integration of AGOL and the leveraging of the Esri topography, street, and imagery basemaps within the **CyberGIS Gateway,** allowing the reuse of content between the two sites. There are now ~300 user organizations registered in Esri's Community Maps 2.0 system underlying AGOL. These organizations have contributed tens of millions of features in over 20 layers. The freely-accessible content within AGOL is continuously growing, evolving, and being updated, thus fueling a host of analytic services in the cloud, as well as geoenrichment services.
- **Geoenrichment**: Using the new capabilities in the ArcGIS API for JavaScript, developers can enrich AGOL data with *interactive* demographics, consumer spending, lifestyle, and similar contextual data (e.g., http://shar.es/iv2O1 and https://developers.arcgis.com/en/features/geo-enrichment/).
- **Social platforms:** Esri is broadening its support of community efforts create social platform for GIS and geographic education. As computing becomes more "consumerized," one of the interesting trends we see revolves around such social platforms. This is driving profound changes, even within commercial companies. For example, at Esri we are doing more and more with GitHub (http://esri.github.io) and using "social coding" practices for our own project management across our development teams. In addition, we are sharing many of our apps online as open source for developers from many user communities to leverage.
- **Ready-to-use-services**: These are new Esri-hosted, cloud-hosted analytic services that perform functions on Esri-hosted, Esri-curated data. These services (e.g., create viewshed, profile, or watershed) assist users with large, complicated, difficult-to-build data such as elevation and hydrology, and can be used either on the web or directly from desktop ArcGIS.
- **AGOL analytics project:** These are GIS analysis capabilities (e.g., aggregate points, find hot spots, create buffers, overlay layers, summarize within or nearby, create drive-time areas, extract or enrich data, find nearest, site suitability, raster analysis, etc.) already built into the web map to help non-GIS specialists quickly answer simple, straightforward analytical questions.

Indeed, in the broader scheme, exposing the power of spatial analysis to a larger audience (the non-GIS audience) may be the biggest long-term value of cyberGIS, and yet pose one of the most fundamental challenges: how best to make cyberGIS easier to use, easier for solving spatial problems, while still maintain scientific rigor? We have more people now who are expert in GIS in its many forms (desktop, server, mobile, and cloud), so there is hope that some of that intellectual capacity could be devoted to making things easier, using the experiences of users to make things more interactive, more exploratory. We can ask questions about phenomena at finer and finer scales, all the while applying more computationally intensive algorithms not broached in the past.

As barriers to entry into cyberGIS environments continue to fall away, confidence in consuming and leveraging both public and private clouds for non-GIS audiences will be bolstered through the successes, ease of collaboration, and agility that on-demand cloud-hosted services can offer. This is ultimately one of the goals of cyberGIS: to integrate and synthesize data and information from multiple sources, thereby facilitating communication and collaboration, and breaking down barriers between institutions, disciplines, and cultures, fostering a better connection between cyberGIS and its many communities.