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GIS in the Rockies, Opening Panel

Denver, Colorado – September 12, 2007

Panelists:

- **Peter Batty**, Former Chief Technology Officer of Intergraph Corporation (see http://geothought.blogspot.com/2007/09/gis-in-rockies-panel-on-service.html for posting of comments)
- **Joseph K. Berry**, Keck Scholar in Geosciences, University of Denver and Principal, Berry & Associates
- **Jack Dangermond**, President, Environmental Systems Research Institute (ESRI)
- **William Gail**, PhD, Director, Strategic Development - Microsoft Virtual Earth
- **Geoff Zeiss**, Director of Technology, Infrastructure Solutions Division, Autodesk, Inc.
- **Andy Zetlan**, National Director of Utility Industry Solutions, Oracle Corporation (see http://apb.directionsmag.com/archives/3332-SOA-for-GIS.html for Directions magazine Blog discussion)

Question: The creation of spatially aware enterprises is at the forefront of GIS application development. However, most enterprises have disparate legacy applications and data sets as well as evolving business requirements that require integration. One solution in the marketplace is the creation of service oriented architecture to support these needs.

- Do you agree that service oriented architecture is the key to enterprise data integration and interoperability?
- If so, how do you see geospatial technology evolving to support the concept of location services and data interoperability?
- If not, what is the alternative?

Each panelist will have five minutes to answer the above questions and then there will be a general discussion with members of the audience.

Response by Joseph K. Berry

Let me start with a couple of disclaimers …as the token academic on the panel, my read of the question likely will be a bit askew from the others. Also, my programming skills have atrophied to a point that programmers tactfully suggest that I shouldn't get anywhere near computer code. As such, my thoughts will avoid a technical critique and focus on the broader scope of the '…*how GIS will evolve*…' portion of the question.

Most definitions of Service-Oriented Architecture boil down to '…a developer technology that supports heterogeneous, loosely-coupled services.' This means a lot to computer scientists, but what does it mean to the rest of us, or more importantly, to GIS technology.

In a sense, Service-Oriented Architecture (allow me to call it 'SOA' for short) is sort of like standardization for data exchange, except it standardizes program integration. Like the Geography Network that is designed to grab a piece of data from here and another from there, SOA is designed to hook together disparate programs. For example, this means that an application can seamlessly mix stuff from Excel with a routing model and then visualize the result as a series of charts, tables and maps. The result is a comprehensive solution rather than a segmented string of the piecemeal parts of a solution.

What used to be independent stovepipes, or silos of processing, are bundled into pool of exchanged data and analytics that holistically address a sequence of steps of a complete application. SOA promises to provide the processing flexibility needed to fully integrate GIS with the wealth of other computer-based technologies. No longer will our field be 'down the hall and to the right' in its walled fortress (or small cubicle) but its visualization and analysis tools readily accessible to other programs.

How this vision plays out is yet to be determined. The idea of program integration has been around quite awhile …beginning with Modular Programming in the 1980s through Object-oriented Programming in the 90s to the current Web Services applications. The dream of 'plug 'n play' programming has universal appeal. However, its practical reality seems to be much different from the vision.

Tim Bray of Sun Microsystems commenting on the term SOA says that "…I don't really like to use it any more. It has, I think become damaged, weakened by over hype, over use, over promise, under deliver. I can't explain what the difference is between SOA and Web Services and I'm not sure I've met anybody who actually can without going into paragraphs and paragraphs of prose. … If you are confused about what SOA really means, it's because the world is."[1]

More SOA bashing comes from Gregor Hohpe, co-author of the book *Enterprise Integration Patterns* who suggests "…some 'alternative' meanings for SOA, such as: same old architecture, some other architecture, SOAP without the P and stupid over-hyped acronym."[2]

While such comments imply that the term SOA is overused, does it mean that the concept is dead on arrival? Maybe the best way to describe SOA is by comparing it to its alternatives. Its polar opposite is the old stand-alone system with self-contained, proprietary software that is constrained to a single hardware environment. Next are Legacy Systems involving homespun corporate local area network solutions. Then there are Internet Portals, such as the Department of Interior's *Geospatial One Stop*, that offers multiple views and applications but does not adhere to the same level of interoperability standards as envisioned for SOA. While there is a myriad of stand-alone, legacy and portal applications, I am not personally aware of any organization implementing non-trivial GIS operations in a SOA framework, such as geocoding and simple buffering.

As a curiosity, how many in the audience have adopted the SOA framework and implemented a mapping solution? …or plan to in the next year? If this was a general IT meeting I suspect that a lot more hands would be raised *(note: no one in the audience indicated that they have adopted; 3 hands out of 200+ were raised to indicate that they planned to adopt SOA in the near future).* So what makes GIS a laggard in SOA adoption— the purported wave of computer science's future? I suspect three primary factors are at play— data, demands, and people.

Dave Bouwman with Sanborn GIS Solutions states that "While this style of architecture works well for a lot of business applications, GIS is different in that there is massively more data involved, and transporting this (as binary or xml) is inefficient. In order to avoid huge data volumes "on the wire", you need to build one-stop services that take simple inputs, perform multi-step complex analyses, and return relatively simple results. Thus, almost all services are custom, which means there is relatively little re-use beyond the scope of the original application— which negates some of the SOA hype. Of course this reuse can be done at the object level, but that's not accessible in the "SOA" framework until you wrap a web service in front of it."[3]

Coupling the multi-gigabyte appetites that clog the network with the huge processing demands of GIS solutions creates a technical bottleneck that is orders of magnitude larger than traditional non-spatial applications. But the perfect storm arises when the 'people-factor' enters the mix. Historically, there have been IT folks who have little understanding and even less patience with oddball spatial data. In opposition there were GIS folks with a geo-centric focus that fueled a 'built here' attitude skirting the larger computer industry.

The fact that the SOA question is being discussed at a general GIS meeting, points to today's convergent trajectory of these two camps— mainstream GeoScience and GeoExploration tools. Traditional computer companies like Google, Microsoft and Yahoo are entering the waters of geotechnology at the GeoExploration shallow end. Conversely, GIS vendors with deep keels in GeoScience are capitalizing on computer science advances for improved performance, interoperability and visualization.

An important lesson learned by the GeoScience camp is that data has to be integrated with a solution and not left as an afterthought for users to cobble together. Another lesson has been that user interfaces

need to be intuitive, uncluttered and consistent across the industry. Additionally, the abstract 2D pastel map is giving way to 3D visualization and virtual reality rendering— a bit of influence from our CAD cousins and the gaming industry.

But what are the take-aways for traditional computer science vendors? First and foremost is an active awareness of geotechnology, both in terms of its technical requirements and its business potential. Under the current yardstick of 'eyeball contacts,' the GeoExploration tools have been wildly successful.

While Service-Oriented Architecture is an important **Evolutionary Step in the Expression and Access** of geospatial data, it is not revolutionary. SOA is child of computer science that is being adapted to geotechnology, not the reverse. It greatly facilitates the development of GIS solutions by providing an environment that brings benefits, but also poses challenges.

My 30-plus years of tinkering with GIS has seen its environments evolve from mainframe computers to mini-computers, to personal computers, to distributed computing, to web services and now the offshoot of Service-Oriented Architecture. What is common at each of these steps is that GIS has gained increasing general awareness and acceptance. In the 1970s there was just a small cadre of a few thousand folks in the world that even had a hint of what "digital maps" were and how they might be used.

Fast-forwarding to today sees 3D visualization as the current lubricant driving GIS's broad acceptance with hundreds of millions of folks viewing 'a CNN zoom-in' to a news hot spot. Society has come to accept —no demand— digital map processing in everything we do from getting driving directions, to seeing your neighbor's property valuation, to zooming-in on a beachfront resort in Belize. Maps used to be an abstract collection of lines, symbols and colors sandwiched on a handy, foldable piece of paper. With any luck, in the not too distant future we will all have a 'decoder ring' that projects a hologram map with real-time fly-through along the lines of R2D2's imaging of Princess Leia in Star Wars.

But at the core, have these technological advancements really changed mapping? …or has just mapping's expression and access changed?

Current **Revolutionary Steps in Analytics and Concepts** are underway like the energized paddling beneath a seemingly serene swan (current GIS expression and access). Recall from your academic days, the philosopher's progression…

from Data (facts),
to Information (facts within a context),
to Knowledge (interrelationships among relevant facts), and finally
to Wisdom (actionable knowledge).

Most GeoExploration applications simply assemble spatial data into a graphic form. While it might be a knock-your-socks-off graphic, the distillation of the data to information is left to visceral viewing and human interpretation and judgment.

For example, a mash-up of a set of virtual pins representing crimes in a city can be poked into a Google Earth display. Interpretation and assessment of the general pattern, however, is left for the brain to construe. But there is a multitude of analytics that can be brought into play that translates the spatial data into information, knowledge and wisdom needed for decision-making. Geo-query can segment by the type of crime; density analysis can isolate unusually high and low pockets of crime; coincident statistics can search for correlation with other data layers; effective distance can determine proximity to key features; spatial data mining can derive prediction models.

While the leap from mapping to map analysis might be well known to those in GeoScience, it represents a bold new frontier to the GeoExploration camp. I am likely reading too much into the panel's question, but the mere fact that the SOA discussion focuses on integrating programs to operate on geospatial data suggests future development of solutions that stimulate spatial reasoning through 'thinking with maps' (information and knowledge) rather than just visualizing data— a significant movement beyond mapping.

In the longer run, I see the current advances in spatial data expression, access and analysis being closely followed by a GeoScience lead revolution in concepts on three main fronts; 1) the nearly 400 year old Cartesian referencing system will be replaced by a hexagon/polyhedral system (think hexagon design of a soccer ball cover) that seamlessly addresses a three-dimensional curved globe; 2) our current reliance on discrete spatial objects (points, lines and polygons) will be extended to continuous surfaces and volumes; and 3) our current modeling capabilities focusing on coincident 2D map layers will be extended to characterizing 3D correlations and flows (particularly important in defense, environmental, health, resources and other applications heavily reliant on spatial relationships and interactions).
A fourth, and even more radical revolutionary front, is the full integration of space and time forming geo-temporal data structures supporting geotechnology. But such a crystal-balling diatribe is moving well astray from even the broad '…*how GIS will evolve*…' portion of the question.

In conclusion, I believe we need to keep SOA in perspective as an important evolutionary step in the expression and access of spatial data that facilitates revolutionary steps in GeoScience. My 30+ years in GIS has tempered a quick embrace of any GIS end-all, silver bullet. However, there appears to be a very interesting three phase cycle in GIS's evolution— a mapping focus followed by a data/structure focus and then an analysis focus.

In the 1970s, Automated Cartography was the rage (mapping focus). In the 1980s, Spatial Database Management and geo-query took center stage (data/structure focus). In the 1990s, GIS Modeling was at the forefront (analysis focus). Today, Multimedia Mapping and visualization in the form of GeoExploration tools are capturing all of the attention (mapping focus). I sense that SOA and a desire to extend and integrate programs, not to mention the melding of GIS and traditional computer industries, are early nudges in the rounding of the tanker toward a GeoScience overhaul of its underlying concepts (data/structure focus) and analytic tools (analysis focus) ...then maybe we can get around to the holographic decoder ring (mapping focus) by mid-century.

Thank you.

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[1] As quoted by Ben Ellingson, Contributor, 08 Mar 2005 | SearchWebServices.com, http://searchwebservices.techtarget.com/originalContent/0,289142,sid26_gci1065615,00.html

[2] As quoted by Rich Seeley, News Writer, 17 May 2006 | SearchWebServices.com, http://searchwebservices.techtarget.com/qna/0,289202,sid26_gci1189019,00.html

[3] Personal communication with Dave Bouwman, Sanborn GIS Solutions, Fort Collins Colorado; dave@davebouwman.com