

Visual area networking: Tools for exploration and enterprise computing

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Two industry trends are converging in a way that creates great opportunities for creative minds—particularly for creative managers.

On one side, we have geographically distributed asset teams that have long felt the business need to view and manipulate data collaboratively for real-time decision-making. Although this has been a focus of oil companies for well over a decade, most needed components are only now available. These include powerful graphical computers, remote displays with platform-independent access to those computers, and software uniquely designed to connect the two—that is, software designed to connect people, process, and data in distributed decision systems.

On the other side, we have oil company and oil services mergers of the recent past that have resulted in national and multinational oil corporations of mega-proportions. Over the next decade, the challenges of oil and oil service companies will transition away from improving exploration success toward production efficiency and optimization—and mega-merged companies will struggle to survive if they cannot optimize their assets. So, which tools will inevitably rise to the surface to accomplish that task? Those same components: powerful graphics computers, clients accessing those computers, and software connecting them together.

Who would have thought we'd see the day when the same graphical computing tools would meet such diverse oil and gas company needs? Not only do they address the needs of mission-critical exploration and production teams, but increasingly they also address the needs of enterprise computing managers concerned about maximizing efficiency and optimization. It will only be a matter of time before managers make the connection and realize what a valuable asset their already existing visualization systems are because it will be quick and easy to turn such systems into decision-making hubs across the enterprise and throughout the oil production process as well.

Enterprise computing needs of mega-merged companies. Let's take a closer look at each of these two sectors in turn. The organizational needs of large companies created through mergers are complex indeed. Mergers, and especially mega-mergers, bring their own set of organizational and management challenges whose solutions directly impact the financial success of the merged company. Companies in one stroke of the pen potentially double their geographic breadth, find themselves with a surplus of qualified people, and inherit disparate IT systems with an often-conflicting array of data and application solutions.

The biggest and smallest mega-mergers alike are typified by mandated, aggressive, targeted property divestiture to comply with government restrictions. The net effect of most mergers is a broadening of geographic distribution rather than an increase in operational density within existing geographies.

Merged companies find themselves with too many employees to operate efficiently. The most common resolu-

tion is to offer early retirement to motivate career employees to exit early. In years past, this strategy proved efficient but, since the middle 1990s, the demographics of the industry have changed, resulting in a different and perhaps unwelcome outcome.

A dramatic decrease in the number of university students majoring in energy sector careers, in combination with severances (both forced and voluntary) caused by mergers and unstable economics, has driven the mean age of the technical workforce up to uncomfortable levels. The result is that companies are being forced to leverage fewer employees across larger domains.

In parallel with—and, in large part, fueling—the current wave of consolidation, economic standards for the oil industry have been driven toward much more stable, predictable growth and return-on-investment-independent of the price of crude. The pressures on finding and production efficiency are exacerbated by the need for 100% clean environmental records and a strong push, at least in the United States, to emphasize any strategy that would lengthen the life of existing fields with no increase in environmental impact. In addition, the major players in the world today are supergiant national oil companies, and multinational players must reach a high degree of financial strength to have the investment and operational credibility to enter such historically inaccessible reserves.

So, the picture we see today involves companies that are combining in order meet their financial and growth targets but, in doing so, are creating organizations facing challenges: their geographic breadth has as much as doubled; their IT infrastructure has grown increasingly heterogeneous and filled with legacy equipment; their expert workforce has diminished; and their need for better decisions and shorter cycle times has dramatically increased

Changing needs in the E&P process. A decade ago, the industry saw tens of megabytes of data as the upper limit to reasonably analyze an oil field or exploration prospect. Today, it's not uncommon for an earth scientist to work with tens of gigabytes of amplitude, derived-attribute seismic data, well data, rock physics, and reservoir data. Our traditional approaches cannot possibly manage the explosion of decision-relevant data in today's volumes (3D/4D/3C seismic, derived seismic attributes, empirical relationship mapping, rock physics, wells, interpretation objects, time-variant geologic processes, production data, etc.). Many field operators proactively reduced the data volumes being collected due to the inability to assimilate it meaningfully, and thus economically into the field management decision process. We now know that the only realistic method of addressing all pertinent data quickly enough to make a difference to the decision is through graphical volumetric analysis, and in most cases, large-capacity and large-format graphical analysis.

Graphical volumetric analysis takes advantage of the human brains' incredible power to process spatially pre-

sented data. We do this every day as we travel through our world, and its application to our modeled world of the subsurface is a natural extension of this evolutionary development of the vertebrate brain. We have had such artificial systems for some time now and have used them highly effectively in nearly all aspects of the oil and gas process.

But the next IT frontier is the interpersonal frontier, in which people involved in the process are connected as it progresses. We can now do this even in the geographically distributed oil and gas exploration and production world without moving everyone into the same building. This is especially pertinent as geographical dispersion increases with companies merging. The result is that experts who are so critical to sound investment decisions are now stretched both geographically and operationally further than ever before. In tandem, the biggest business performance improvements will migrate away from increasing the exploration discovery percentage to increasing the recovery from existing assets and extending their life decades beyond what was initially envisioned when fields were put on line.

The latter strategy in addition resonates with environmental and national security concerns, in the United States and around the world, whose agendas are to encourage the production of more oil from existing fields and to decrease future reliance on imported oil from unstable or potentially unstable geopolitical regions—thus minimizing the footprint of the production operation and taking greater advantage of those resources under local control. Of course, recovering incremental reserves from established, largely capitalized/amortized fields is a major financial win for the operators while achieving the objectives of the other concerns.

Early forays into connecting remote team members were

pioneered by a few companies who experimented with the concept of the “virtual oil company.” These companies spent a number of years trying to connect their necessarily globally distributed operations, attempting to create an environment equivalent to that in which their experts were cheek-by-jowl in a large corporate office. But the technology infrastructure and corporate cultures to support it were lacking. The principal cost barriers have been broadband networks—which are dropping quickly—but, even with infinite bandwidth at no cost, the collaborative infrastructure (software and hardware) was not functional. In addition, key components to the total solution, which include real time processing of data from producing fields (especially downhole production arrays, field-wide real-time passive seismic surveys, and surface facility monitoring) were not available, and even today robust solutions to converge static and dynamic data from the field managed in “command and control” settings are not fully mature.

Central to the corporate cultural barrier has been the broad acceptance of volumetric decision systems as the platform of data intensive work processes.

Volumetric visualization of seismic data was introduced to the oil industry in the early 1990s yet today’s work process remains dominated by 2D section analysis approaches. All major software development companies and many others now have robust products whose use has been demonstrated to shed days, weeks, and even months off of the decision cycle time, and improve the financial quality of the decisions tangibly, measurably, and significantly. VAN/DGDS (this lengthy acronym is defined in the next section) extends the reach of the volumetric approach both geographically as well as operationally focusing on the production asset team collaborative processes.

(Continued on p. 935)

(Bartling, from p. 885)

Today, nearly all required technical components can be delivered and the business case for the “virtual oil company” is stronger than ever. The price for broadband has and will continue to shrink and the return on investment for IT infrastructures that support this are increasing as improved performance based on this and other technologies is documented around the world. Companies both large and small have been investing in high-performance computing and visualization technologies to enable this process, moving into a system where they are able to use tools that allow the viewing of large and substantial quantities of data. Enhancing the power of these very powerful applications are accessory products that deliver crucial, decision-relevant petrophysical- and rock physics-based analysis of seismic volumes for improved management of producing reservoirs, either as a batch process or as a real-time computational module attached to the volumetric application.

VAN: An idea whose time has come. Early this year, the concept of visual area networking (VAN) and distributed graphical decision systems (DGDS) was introduced, articulating the business case for collaborative computing and providing a framework within which the infrastructure for collaborative work can be accomplished. Now, VAN and DGDS provide the structure for collaborative work to be accomplished. This capability combines technologies from graphical supercomputers and cutting-edge visualization applications using either broadband communications systems or typical LAN/WAN bandwidths. These recently introduced specialized networking and graphical systems paint the business case for collaborative computing. A business process-focused tool, Visual Area Networking positions high-performance graphics at the core of the technical computing enterprise, allowing large, complex data volumes to be analyzed rapidly. This technology applies across the spectrum of oil and gas work process ranging from the production asset team through exploration teams and even into the seismic data processing shop to provide real-time, interactive parameter selection and processing check print approvals with the customers, but utilizing a robust volumetric interface rather than the traditional 2D sections.

VAN is the centerpiece of extending powerful visualization and analysis tools to the technical computing enterprise, extending the idea of using graphics to make decisions by allowing users to share images with other users anywhere, anytime, on any device in real time. VAN in addition is the platform for DGDS, which manages the necessarily distributed data, distributed people, and distributed processes and converges all elements into a common view accessible throughout the technical computing enterprise.

Robust data access systems power the storage area networks (SAN) that capture and serve data to the computational and graphical nodes at rates necessary for real-time decisions. Distributed graphics instantly incorporate the wisdom of distant experts in the process. Powerful computational engines compute and deliver to the distributed graphics infrastructure results that reflect current conditions in the reservoir, not months old performance. The goal is to bring any and every key expert into the decision-making process in real time, whether they're in the field office, collecting data from the wells, at corporate headquarters, on a drilling rig, or involved in seismic operations. Behind the scenes, everything runs quickly and smoothly because the infrastructure allows data to reside in many different places yet still be rapidly accessible by the technical com-

puting enterprise.

At the core of the VAN concept are powerful graphical computers capable of rendering fully populated seismic or reservoir scale models at extraordinary and unparalleled resolution, speed, and clarity. At the end nodes, virtually any device can take control and thus deliver supercomputer capability to the desktop and also collaboratively to the asset team. Thus DGDS are heterogeneous—i.e., completely compatible with operating systems from other companies.

Users can also connect to VAN using readily available wireless Internet protocols. This capability will be demonstrated at SEG's Annual Meeting in Salt Lake City, where every type of VAN end-user, from powerful UNIX-based workstations and desktop PCs to tablets and wireless Internet terminals, all sharing and manipulating images across local and wide-area networks, will be showcased. One clear advantage of wireless connectivity is that the user can be remotely situated on a platform, in the field, or even in the coffee bar in the office while still participating in the decision session. This gives users unprecedented mobility in their operations while interacting in real time in a geographically distributed, collaborative graphics-based decision process.

In addition to having distributed graphics and distributed data at their fingertips, users can analyze a mixed combination of static data (seismic data, well data, or even weather data such as hurricane warnings) and dynamic data (information from the wells, passive seismic monitoring, etc.), which is key to the real-time decision-making model. To do this, the central processing system (graphical and computational nodes) must be able to rapidly compute and refresh these complex models in real time so that the distributed group always has access to the most current, up-to-the-second information with which to make operational decisions.

The most effective way to analyze these large reservoir or exploration volumes is in a large-format visual environment. New applications rapidly navigate through these volumes with the ability to simultaneously compute other attributes, adding additional information key to improving the operational success of the field. All these data are stored in the computer memory and are visualized in real time, typically in large-format, theater-type rooms and, more recently, in distributed formats through VAN.

Is “convergence” really an outdated word? Invoke the word convergence in an IT or multimedia conference, and the fashion police will cite you. Though the word may indeed be unfashionable in those circles, it appears to have new relevance in the oil and gas industry, where an unexpected confluence of factors is leading seemingly siloed teams within energy companies down the same path: toward distributed graphical decision systems. **TJE**

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