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Challenges in Integrated Operations Centers

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Abstract

Oil and Gas companies increasingly need environments that support real time E&P business processes, by linking well site information, applications, and experts with operational managers (decision makers) in one place, where daily operational parameters are viewed, decisions are made, and decisions are acted upon. Most companies believe that making decisions in real time while leveraging global resources and infrastructure will help improve their productivity from mature fields, while reducing costs.

Project team members are often collocated to ensure open communication and planning. However, E&P activities often take place in remote and hostile parts of the world, where it may not be possible or economical to deliver all the required resources and personnel. Global operations frequently require that operations centers be "virtualized" so the team members can be globally dispersed. Reliable and secure information flow is the key to ensuring success in the oilfield of the future.

Creating and supporting such integrated operations centers presents significant challenges in process, networking, security, hardware, and software infrastructure. For example, end-to-end real-time solutions require remote connectivity and “first mile” technology.

Successful creation of integrated operations centers requires clear definitions of the business processes to be supported and the infrastructure technologies needed to support them.

This paper discusses some of the special challenges faced in the upstream oil and gas domain, with examples of how some of the challenges have been met.

Introduction

Exploration and production companies are turning towards integrated operations centers as a means of gaining advantages in operations such as drilling and production, where access to real time data and analysis can lead to gains in productivity and efficiency. Operators and service companies have a range of strategic business activities that may be referred to as “real-time.” These strategic businesses are global, sophisticated systems needing many elements of infrastructure to carry those business applications.

Operating companies and associated service companies have extensive expertise in their core operating processes. Their staff personnel want to use such centers as a resource to improve their work processes, and not as a classroom in solving information technology problems. However, the very nature of the data and processes used in these centers stresses IT capabilities. Internal or external IT service providers must address several issues to ensure that the centers support the core work processes

There is a need to improve the management of the infrastructure elements, so that the performance can be predetermined, and the recovery from unforeseen outages is sufficiently fast to be aligned with the whole business concept of “real-time”. This recovery from failure is probably the main criteria by which many users would judge success or failure of the operation. The duration of any network outage must be kept to the absolute minimum. The term “Real-time” has also been described as “Relevant Time”. The infrastructure enables a real-time operation to be monitored and managed remotely.

This adjustment to align resources to the business needs involves:

- Excellent communications across the user groups, and between the respective domain experts
- Network management tools that can monitor the network and the performance of the business application end-to-end
- A single master database of job and problem, tickets, with the necessary active tracking systems
- The integration of these tools into the same management processes
- The realization of this real-time vision demands that these systems are staffed by people who are aware of the user’s business environment.

Real-time services and the associated advanced workflows require that a number of components, groups and technologies work together seamlessly and reliably. Many of these components have different owners, little coordination between

owners, and no consistent or effective method of funding. Service quality to the segments and clients suffers as a result.

To organize these elements, the authors have coined three phrases:

Workflows that work

The design choices that are made in system development must be driven by the uses for which the system is intended. Different E&P operations are supported by integrated operations centers. They vary from interactive well operations such as wireline logging and drilling to monitoring operations such as production or equipment surveillance. The workflows necessary to support these operations must be well understood between the IT service providers and the end users and domain experts. For this paper, we consider workflows that support remote wireline logging operations, remote drilling operations, well services such as fracturing, and surveillance services for equipment and production.

Ready to run

.Integrated operations centers are actually part of a complex end-to-end system covering remote data collection, data transmission and reception, data management, data processing and analysis, and remote visualization and interaction. To achieve the benefits, the system must be developed, configured, and delivered "ready to run." The IT requirements as derived from the business requirements must be met and managed with a combination of IT tools and management practices.

Business model that makes sense

Introduction of new capabilities such as those in integrated operations centers must be done with proper attention to the business realities. Allocation of costs is one of the most important of these realities. In the old versions of centralization, IT infrastructure costs were simply allocated among business units, which had little control over the system and few incentives to manage its usage effectively. A new model must strike a balance between the simplicity of central control and the transparency and accountability of local control.

The IT Requirements for a Ready to Run Service

Several IT requirements must be met to tie all of these parts together in one consistent and efficient offering.

- End-to-end service management

To assure the system can support real time operations, all the hosting and connectivity must be monitored and managed.

- Service desk function

To ensure continuous system functioning and improvement, service desk and ticketing system, is needed..

- Specify SLAs

An SLA is an agreement between the client and the service provider that defines the level of service to be delivered. It is arrived at through a price and performance analysis. To provide a meaningful SLA, the relevant ends of a complex infrastructure need to be identified and the needed KPIs need to be agreed upon.

If any one of those elements is then recognized as particularly weak or sensitive, and the business case justifies increased expense to upgrade it, then an improved SLA and delivered SL will be the result. If that performance is found to be inadequate during the implementation phase or later, an upgrade would need to be considered, designed, and the cost re-negotiated.

SLAs can cover such items as latency and reliability or availability. The requirements for these are driven by the actual business need.

- Assure Security

The security of the customer data is of primary concern. A loss of trust in that domain would be classed as catastrophic. However, investment in security must also be a balance of cost and benefit. What is required is a system that is regarded as generally following best practice and specifically focused on addressing the threat posed. It generally can be demonstrated as fit-for-purpose secure through a recognized audit process, and that it is not susceptible to bad work practices.

- Manage the end-to-end service

The definition of the "ends" of an end-to-end service must be done with care. This must be done through an integration of the application system monitoring with the monitoring for the linking network.

Ideally, the entire offering is static with fixed known costs and corresponding SLAs. This would make it easier for a customer to plan and deliver their highly dynamic services. That must be the default situation. The end-to-end managed service may need to be a mixture of static and dynamic components, and SLAs.

During the start-up phases, there could be considerable benefit to be able to respond to some highly dynamic demands for special cases. This would be in a format that can predict performance problems with sufficient time that they can be averted, and that can respond fast enough to a new client request for an element upgrade to ensure that a new SLA can be agreed and delivered.

Technical overview

To meet the above needs, one approach is to create a hosting facility to serve as a hub for a region. Such a site will need to

- Host the respective servers, and provide resilient network connectivity to both the Internet and to user's private networks.
- Monitor and manage the performance of the servers and additional devices, at each site.
- Monitor and manage the relevant networks
- Monitor and manage the performance of the applications across the network.
- The above system management implies that trends will be identified so that pro-active corrective actions can be taken to maintain the required quality of service.

Equally important, a set of management practices and policies should include a global service desk (GSD) facility with a single master database of job tickets, both open and closed. Closed tickets are of great value as the source of statistical information for management purposes. This service s requires appropriate IT tools, plus appropriate staff training, and 24/7 global availability.

Using a systematic approach means that the quality of the infrastructure will be greatly improved and will be sufficient for the users to deliver their business and even mission critical services in a reliable and predictable way. There will be

Service Level Agreements (SLAs), between client and provider to support their business needs.

The overall systems costs will drop over time as greater efficiencies build up through cross-training and such services as the Global Service Helpdesk (GSD). GSD efficiencies stem from the build- up of a knowledge base and trouble shooting scripts, all accessed through specialized software systems. Most system problems repeat, so a learning system becomes more and more efficient over time. These efficiencies feed through to both better quality service and a reduction in costs.

The system elements

The end-to-end system includes data sources, transmission services, application servers, and user services. The needs for the system are driven by the actual oil and gas business processes to be supported.

Data sources

Data may come from down-hole gauges and pumps such as the ESP (electrical submersible pumps). There can be many hundreds of these in an oilfield.

Other data can be quite diverse to categorize and can include data from frac jobs, drilling, wireline logging, and well testing. These can have high data rates and be highly interactive between remote ends.

Input (feeder) network

Production data may require relatively low bandwidth into the centre, from the well sites. The field data may be aggregated through various links:

The networking requirements would typically be two orders of magnitude higher for well operations such as wireline logging than that for well production services.

For example, each incoming data stream for a wireline operation should have a bandwidth of between 32kbps and 512kbps, in order to cover most operations efficiently. That bandwidth requirement would is typically be for 3 days at a time twice a month, if an offshore or remote location. If the remote site is a high- utilization land- based activity, then that need could be for 24 hours every other day.

If the incoming data is for a drilling operation, then a steady low- bandwidth is generally sufficient, along with bursts of higher bandwidths every few hours. This type of operation will typically continue throughout the drilling of the well.

If the incoming data is from a fracturing operation, then the requirement is for low bandwidth, high availability, and low latency performance.

Many of these operations must be considered as "Interactive Real-time". An outage of minutes will cause considerable anxiety and significantly affect the service quality. An outage of hours would definitely be classed as a catastrophic fiasco, carrying major elements of risk to the client's assets and would probably result in the client not risking utilizing the service again.

Server Hosting

This must have the basics of a professional hosting facility:

- Robust, backup power facilities, preferably dual power grid, and supported by a UPS and automatic generator.
- Robust air conditioning, with backup system
- Redundant telecommunication links supplied through different ducts into the building and terminating at different Telco POPs.

Output network

For production operations, the "output" network is really the link to the client in this case. This is provided through a web interface through via the Internet. Therefore, the resilience of that web interface is important for user satisfaction. The required bandwidth and performance of that link is superior to that of the incoming links, due to the client viewing graphics and complete data sets in one session.

For well operations, this output network is also the link to the client, normally through the Internet. This can be the continual streaming of data as it is being acquired at the well-site well site. The "data" can be in processed graphical format, and or large raw data files. This information is typically used in real time to make operational decisions for the wellsite. These decisions may need to be taken in minutes or hours. This link is therefore resilient with two physically different access points through the Internet.

Common needs of Production and Well Operations

From the above sections covering the main aspects of the different real-time application services, it is evident that they have many different characteristics and requirements. The shared requirements, however, are-:

- A robust hosting facility, (which implies redundant connectivity paths, particularly to the Internet)
- A global ticketing system for managing job entries and operational problems
- A monitoring and management system for the servers and network
- A service to monitor and manage the application performance
- Standardization and use of best practices

These sites must be physically robust enough to resist damage from malicious intent, from accidents, or from severe weather.

The service elements

Several service elements are also needed.

Helpdesk and single ticketing system

A unified services desk would simplify the management of all issues, whether related to details of the technical operations or more traditional IT issues such as network or servers .

The single help desk system can help improve quality because it is effectively a "learning system" that should become more efficient as the knowledge base is built up, this is then accessible for repeated and expedient use. Trends can be identified from the recorded statistics, so predicted behavior can be used to steer management decisions.

By using a professional[1] global service desk (GSD) facility with a single master database of job tickets, both open and closed, closed tickets can be used as the source of statistical information for management purposes.

[1] "Professional" here means that this service is regularly audited for ISO certification, and that it provides services to third party companies on a competitive basis.

Network and Server Monitoring and Management

The system requires a full suite of network management services including:

- Network monitoring services with real-time network capability
- Network fault management services with remote resolution and, if needed, escalation according to defined customer procedures
- Configuration management services to implement desired changes to the network
- Performance management services to maximize network capabilities
- On-line access to near real-time and trend reporting
- Management circuit for connectivity between the customer and Network Solutions
- Project manager to oversee deployment of services and the resources required to roll- out service and provide any necessary configuration
- Service delivery manager for ongoing operational issues and requests

Performance Management Components

Performance management should define, collect, present and act on the following performance metrics:

- Application Availability
- Selected Transaction Response Time
- Application Server Response Time
- Network Response Time
- Traffic analysis (protocols, hosts, conversations, volumes)

Two main techniques can be used in performance monitoring. One is *passive monitoring*, where a probe will observe actual traffic and compile response times for server and network. The other is *active monitoring*, where performance is measured from end points on the network to points where synthetic traffic is generated.

Performance Management Services

To monitor the performance, reports can be generated for:

- Application Availability
- Selected Transaction Response Time
- Application Server Response Time
- Network Response Time

In addition to regular reporting, the performance management service may also offer e-mail alerts to be sent to selected individuals or groups to notify of any threshold violations.

Security Services

The elements of security that must be covered are:

- The network
- The data on that network
- The servers and systems providing the hosting service
- The client machines that access the service
- Recovery from disaster with any aspect of the primary store of the data
- User's perceptions about security and the value they assign to their data

The Staff Elements

The following staff are needed to make this system work.

- Implementation project manager – to manage the implementation, and then hand-over to the service delivery manager
- Project setup team members on a temporary basis :-– to set up reporting forms, etc.
- Network Performance Analyst:- – tool specialist with very specialized knowledge of the network tools and ability to assimilate the information so that appropriate management steps can be taken
- Service delivery manager – to manage the service delivery into the future
- Operations staff – as needed for the operational volume at 24/7 availability

Business Model that Makes Sense

The costs for an integrated operations center include:

- The hardware for the servers
- The costs of the implementation at the hosting facilities
- The costs of management of the servers
- The costs of the network access
- The costs of the Global Service Desk
- The costs of the application performance management service
- The costs of the operational staff

Not surprisingly, the need to have a business model that meets the need of all the stakeholders is normally an obstacle to ensuring that such solutions are quickly adopted company-wide and optimized to meet the business need.

While it is generally recognized that centralized infrastructure can help cut costs and often offer greater reliability, the business model that accompanies the centralized model is not popular with business units. Normally, the model is based on recharging all the costs to the business units on a simplistic parameter like revenue or number of units. This model leaves the business manager with no control or flexibility in reacting to business needs or adjusting usage based on economic parameters. Especially in the case of a worldwide deployment, where certain business units may not see any benefit for a while until the infrastructure is put in place, this can be a major obstacle. The advantage of this model is that is simple to administer.

On the other hand, a completely decentralized model - that is totally flexible and leaves each business unit complete freedom to choose the infrastructure and the resources as per their own needs - is highly inefficient.

In our experience, we found that having a business model that accommodates the best of both extremes is the most likely to be widely accepted and efficient. The key elements of this are:

- Initially, the costs that are common for the shared infrastructure are reallocated to the business units based on a simple parameter like revenue. This enables the central build out of the optimum infrastructure based on the overall business needs.
- Business units have the ability to buy, at well-publicized rates and service levels, products and services from the central pool to suit their individual needs, thus, giving them the flexibility and control over the variable portion of the costs.

- After the build out of the infrastructure phase, the model transitions to a pay per usage based on their needs. This achieves the goal of transparency to the business units and ensures that the overall costs are kept aligned with business evolution.

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Conclusion

The time is right for real time oilfield operations. Many projects have been performed around the world, and the benefits to the industry are becoming increasingly evident.

Since the infrastructure demands created by these operations are so high, it is important that internal and external IT service providers be prepared to offer repeatable, optimized tools and processes to support them.

In our organization, we have created such processes and services. Centers meeting the requirements described in this paper have now been operated for over a year.

One such center has acquired an average of over 400 mbytes of real-time data per month. It now has over 2 million data files, and over 28 tera bytes of real time data under management. In addition to over 25,000 remote wireline logging operations annually, and about 300 fracturing operations per month, it has been handling continuous acquisition of production data from over 700 wells.

The ability of this installation to handle the large amount and large variety of data and transactions, without security incidents or system outages, shows that a systematic approach to workflows, infrastructure, and business model can meet the challenges of integrated operations centers today.