Schedule delays, cost overruns, operational problems, and potential safety issues have plagued the installation, commissioning and start-up of large, integrated drilling control systems. A root cause of these problems is that the software interface between the computer controlled equipment (like Top Drives, Pipe Handling Equipment, Drawworks, and Iron Roughnecks) and the integrated control systems (like Cyberbase, V-ICIS, and DMCS) is not standardized. That puts the onus on the integrated control system to resolve any differences in the location and meaning of the various software interface points. Since there can be anywhere from 2000-8000 such points, the potential for errors are great, and the time to discover and resolve the errors can be long. Worse, these errors are often only detected when the equipment is physically integrated at installation time.

Imagine walking up to a laptop connected to a data projector, inserting your USB memory stick into the laptop USB port and having a screen pop up saying “Please enter the Intel x86 Assemble Language code to access the data on your memory device.” Oh, and once you do that you then have to define the bit map format of the file on your USP stick. Sound unreasonable? It is! But, that is what happens today when you try to upgrade equipment or put together a new drill floor on your drilling and production platforms. Schedule delays, cost overruns, operational problems, and potential safety issues have plagued the installation, commissioning and start-up of large, integrated drilling control systems. A root cause of these problems is that the software interface between the computer controlled equipment (like Top Drives, Pipe Handling Equipment, Drawworks, and Iron Roughnecks) and the integrated control systems (like Cyberbase, V-ICIS, and DMCS) is not standardized. The diagram at the left shows the software pain points for the connections between the DCMS and the equipment control – PLC, SBC or work station.
Deliverable 1: Feasibility model of a SECS/GEM equivalent system for drilling.

1. Development of a feasibility model for a SECS/GEM equivalent system for drilling, developed by the Athens Group, demonstrating potential solutions for the pain points of computer-based drilling equipment integration.

2. Demonstrate solutions to installation issues, such as automatic discovery, mis-wiring resolution, capability changes, automatic alarm mapping and reporting.

1. Feasibility model of a SECS/GEM equivalent system for drilling, developed by the Athens Group, demonstrating potential solutions for the pain points of computer-based drilling equipment integration. Specifically, the feasibility model would include a demonstration model of one or more of the following: a Top Drive, a Pipe Handler, a Drawworks, or an Iron Roughneck; along with a DCMS like Cyberbase, V-ICIS or Sense. The model would demonstrate solutions to installation issues, such as automatic discovery, miswiring resolution, capability changes, automatic alarm mapping and reporting.

2. Consultation with drilling equipment providers would be included to make the number of data points and commands limited, yet realistic to make an assessment of suitability. Athens Group-sponsored workshop for operators, contractors, and equipment suppliers to educate about the SECS/GEM model and to demonstrate the feasibility model.

3. Report from interviews with major equipment vendors regarding issues in applying the standard as well as commitment to participate in Phase II.

Specific Phase I Commitment

- $100,000 total ($25,000 for 4 sponsors)
- Completed on 6 Month Timeline

At the end of phase one, there will be a demonstration of the feasibility of developing concise and inclusive software that eliminates the delays in integrating, commissioning and putting automated drilling equipment into production. This is the first step in solving a multimillion dollar productivity problem in our industry.
Athens Group uses an internally developed and hosted web application called Autoweb to create and maintain project web sites. These web sites help the project team members manage project documents and facilitate communication among themselves and with project stakeholders.

Is my proprietary and confidential information protected from unauthorized access?

Yes. Protecting client information was a top priority requirement for the design and development of Autoweb, and continues to be a primary consideration in determining the way it is used and supported.

Can other Athens Group clients gain access to our project sites?

The only way a user gets access to a site is for the authorized site administrator (usually the Athens Group Project Manager) to grant that access from within that site. Each of our clients is assigned a separate namespace, called a domain, and each users’ domain association is clearly seen as a prefix to their user ID during all user management functions, to avoid cases of mistaken identity.

Can file uploads or downloads be intercepted on the internet?

All web traffic to and from Autoweb is encrypted using SSL. Users can help make this stronger by using High-Encryption on their browsers (128-bit versus 56-bit).

Are the servers to which my data gets uploaded secured?

Yes. Our network is secured using a dual firewall system implementing the best known practices. All access to our network (for VPN, email, and Autoweb) is directed first to a fully hardened and carefully protected server in the “demilitarized zone” (DMZ) between the two firewalls. The second firewall allows only “point-to-point” communication from each DMZ-placed server to specific shared internal resources within the network. Autoweb requests are directed to an internal Linux server running Jakarta Tomcat, an open-source Java web application server that protects access to all files and pages within its purview, via integrated secure authorization and authentication services.

Operator Leadership is Essential

• Lesson from SECS/GEM: equipment developers and Chip manufacturers could get nowhere agreeing on a standard (politics, time pressures), until Intel, Motorola, AMD demanded it

• Equipment vendors and drilling contractors, responsibly running their business, will invest in those projects with proven, tangible, short term benefits. Operators must put the development of Plug and Play standards in that category.

Using an example familiar to our industry, standards for grading drillpipe and classifying types of connections assure that drillpipe, regardless of manufacturer, can be effectively and safely integrated at the rig site and be fit for the purpose intended. There is no equivalent standard for drilling equipment. This situation is most acute when multiple vendors are used, but even exists when one vendor is used, since internally one vendor may have many product lines, and multiple products within those lines.

The development of standards equivalent to those developed for drillpipe would address many of these issues.

Other industries, notably the automotive and semiconductor manufacturing industries, wrestled with exactly the same situation 10-15 years ago. In response, the semiconductor industry has developed a set of standards known as SECS (SEMI Equipment Communications Standard)/GEM (Generic Equipment Model) to allow fabrication equipment from multiple vendors to integrate seamlessly on the factory floor. These standards were developed from similar standards which were developed for the automotive industry. SECS/GEM standards implement functionality familiar to computer users as “Plug and Play”.

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Why do we have to keep learning from experience?

- Setting locale/language to Norwegian on X-Coms PCs in attempt to correct time-synching issues caused chairs to freeze when decimal numbers were input. (System was expecting comma instead of period as decimal point.)
- Change in top drive torque release logic to fix special case for control from manual console resulted in erratic results every time torque was ramped down to zero from chairs.
- FMEA, FAT and commissioning done on top drive and declared fit for purpose. Failed consistently when connected to DCMS.
- Active heave drawworks had logic inserted to delay motor start for 6-10 secs to give lube oil system time to ramp up pressure. This essentially defeated expensive and highly-engineered anti-slip feature previously put in place, intended to catch a load detected to be slipping by starting the motors to catch it. The system thus allowed the load to slip for 6-10 secs while it made sure the gears were properly lubed!

Examples from the last 6 months on problems that could have been either quickly resolved or never occurred in the first place with standardized equipment control. An excerpt describing the functionality of GEM-compliant equipment demonstrates the potential applicability to drilling equipment: “All GEM compliant manufacturing equipment share a consistent interface and certain consistent behavior. All may communicate with a GEM capable host using either TCP/IP (using the HSMS standard, SEMI E37) or RS-232 based protocol (using the SECS-I standard, SEMI E4). Often both protocols are supported. Each piece of equipment may be monitored and controlled using a common set of line management tools defined by GEM. When equipment has GEM interface, it takes just minutes (or even seconds) for factory GEM host software to establish communication and begin monitoring the machine’s activity. This means that equipment manufacturers may spend more time and money improving the machine’s quality by providing a common interface to all factories. It means that factories may spend more time and money improving production and processes, rather than setting up communication to the machines.”


The Athens Group has experience in developing and implementing SECS/GEM standards and software tools for the semiconductor industry. In our industry, they have consulted on several major rig construction projects involving integrated drilling systems, verifying the proper function of the integrated software systems, and identifying software and software development process problems.

Based on their experience in these industries, the Athens Group believes that SECS/GEM standards can be effectively applied to computer controlled drilling equipment and their networked control systems. Like Plug and Play commonly seen on Windows PC’s, this will allow standards-compliant equipment to integrate easily on the rig floor, regardless of vendor.
Adapting SECS/GEM

- Data structures and protocols already developed
- Non-technical issues associated with standard adoption known
- Successful
- Provides transparency to how and what the software does
- Replaces the black box recorders that do NOT track all alarms, events, commands and data.
- Features
  - Common Interface
  - Vendor Interchangeability
  - Automatic Discovery
  - Rapid detection and resolution of interface discrepancies
  - Simplifies contract compliance issues between buyer and seller

Phase 1 Deliverables

- Apply SECS/GEM standards to the basics of how drilling equipment works.
- Extend the standards to DCMS.
- Implement the basic communication blocks: Commands, Events, and Alarms
- Implement the “discovery” process of a new or newly configured piece of equipment.
- Implement Drilling Generic Equipment Model for material movement and process status monitoring.

These deliverables are based on the demonstration given at the DEA meeting on Nov. 18, 2004.

SECS/GEM standards are described at: Cimetrix, *An Introduction to the GEM Standard*, http://www.cimetrix.com/gemintro.cfm

COMMANDS: The host tells the equipment to Start, Stop, Pause, Re-start; it verifies that the wafers are at the correct process step and the equipment has the right processing information.

EVENTS: The Equipment updates the Host as it completes a task, changes state, or moves material. It provides data which can be as simple or complex as necessary. The data associated with each event is defined by the Host system at start-up. Some data examples are: Lot ID, Start Time, Elapsed Time, and Chamber Temperature.

ALARMS: The Equipment notifies the host that there is a problem; there are standard Alarms and custom alarms.
Just as drilling equipment on the rig communicates with and responds to the chair, the semiconductor equipment on the factory floor is tied to a main controller called a “host”. Equipment can be linked by either an RS232 line or via the Ethernet, according to the standard. The series of communications between the equipment and the host includes Commands, Events, and Alarms with necessary data.

This represents the GEM part of the standard - Generic Equipment Model. It depicts three possible states of the equipment (IDLE, SETUP, and EXECUTING) and the events that can occur in each state. The standard is extensible in that you can add as many sub-states as you need.

A state change from one state to another can be triggered by a Command, an Event, or an Alarm. You may also have events that do not trigger a state change.
The following two slides show the interfaces used at our demonstration, but keep in mind that these are just for simulators — the interface used by the operator at the equipment or host could be much different depending on what process is underway.

This is the Host Interface. It shows what the host sees as the Communications and Control state.

- Communications state: is there a link and is the equipment responding?
- Control state: is the equipment being controlled locally by an operator or remotely by the host?

In the Processing & Process Programs the interface shows the current state of the equipment, what processing programs are available and allows the user to simulate the sending of a command such as Start, Pause or Abort.

This is the Equipment interface used for the Demo.

- It provides status information
  1. Communications
  2. Control
  3. Processing State
- It allows the user to simulate the sending Event messages (see Custom Commands at the bottom)
  1. Event: Material Rcvd
  2. Event: Process Program Verified
  3. Etc.
- It allows for Enabling/Disabling or Adding a new Alarm (see Alarms section)
Discovery Log

Log Trace window #1 is from the initialization of equipment and host communications. ">>S<<" denotes messages the host sends and "<<<R<<" denotes messages the host receives. There are standard request/response pairs (S1F13 and S1F14, for example). In the last pair, the host is requesting a list of Enabled Alarms (S5F7) and the equipment responds with a listing (S5F8).

Log Trace Window #2 continues the discovery process with the host requesting the following:
- List of Status variable names and data (which may include things like current state, lot at port 2, etc.)
- List of Equipment Constants names and data (these are things like model number, software revision, etc.)

In the last pair of messages, the Host tells the equipment to go ON-LINE, meaning the equipment will be taking directions from and sending updates to the host until either the host tells it to go OFF-LINE or an operator at the equipment initiates going OFF-LINE (to do maintenance, for example).

Log Trace Window #3 shows the host first disabling any existing Event Reports and then gives the equipment the Definitions of the reports that it wants. For example the host can specify that it wants the wafer ID and chamber temperature variables each time the Wafer Completed event occurs. It then enables the newly defined reports.

A few other “housekeeping” issues are addressed, such as what to do with any spooled data which may have accumulated during a period when the equipment could not communicate with the host.

Your Next Steps!
1. Review all material in the package
2. Have JIP Standard Participation Agreement reviewed and approved
3. Ask Athens Group for any further clarification
4. Send in your sponsor fee for Phase 1