LOGIC Technologies, Inc.
P.O. Box 189 -117 Bellamy Place - Stockbridge, Georgia 30281 - Phone (770) 389-4964 - Data/Fax (770) 389-4871

Engineering White Papers

SST vs. Common Control Schemes

Author: Mike Vinson

Table of Contents

1 Document Overview

The following document is one of many white paper documents that are created by members of the LOGIC Technologies, Inc. engineering staff to describe various processes, procedures, and aspects of the systems that we produce. The complete set of documents can be found in the online help system and printed service manual that was provided with your system. If you feel that information related to a document's subject matter is lacking, please contact the LOGIC Technologies, Inc. sales staff to request an updated document.

This particular document was developed to provide a comparison of LOGIC Technologies, Inc. SST (Signal Server Technology) based control systems to common control scheme systems/architectures that are provided by our competitors. It should be clearly understood that this document was not created to critique the systems provided by our competitors. The document is instead simply intended to provide our customers and end-users with a single source reference for comparison purposes.

1.1 Document History

Date	Author	Version	Description
12/7/2006	Mike Vinson	1.0	Initial Version

2 Glossary

LOGIC Technologies, Inc. white paper documents are intended for use by all interested parties regardless of their technical expertise. This section of the document is therefore provided to define technical acronyms/mnemonics used in the document.

Acronym	Abbreviated Term	Definition
SST	Signal Server Technology	A design methodology developed by LOGIC Technologies, Inc. that permits the interfacing of real-world input/output signals into a networked environment.
PLC	Programmable Logic Controller	A digital controller used for applications such as on/off control, timing, logic, counting and sequencing.
HMI	Human Machine Interface	Generic software and/or hardware used to provide control system users with an understandable interface to manipulate or monitor control processes. (Wonderware, RSView, etc…)
dbc/OS32+	Operating System	dbc/OS32+ is a real-time 32-bit operating system developed specifically for control systems.
ECON	Engineering Console	LOGIC Technologies, Inc. Engineering Console and HMI Application Suite
MICRO	Micro Controller	Typically a small form factor (PC104) dedicated computer panel containing its own I/O points for control purposes.
PID	Proportional, Integral, Derivative	A control process which provides a variable output that is proportional to the processing rate.

3 Common Environmental Control Schemes/Architectures

Environmental control systems are somewhat unique due to the number of analog points that have to be considered in the decision making process. Control vendors have utilized several architectures over the years to implement these systems. Most control vendors today provide either a generic PLC/HMI based system or a network of dedicated MICRO (Micro-Controller) units. LOGIC Technologies, Inc. on the other hand offers customers a third choice through SST (Signal Server Technology).

3.1 PLC

Programmable Logic Controllers or PLCs were first implemented by the General Motors Hydramatic division in 1969. Early PLCs were designed to serve as little more than solid state relay replacement systems. The most significant advantage of these systems was that control logic could be modified without costly wiring procedures. Since engineering and maintenance personnel already had a firm grasp of ladder diagram schematics, the controller programming interface was develop to closely mirror ladder diagrams. News of this wondrous new device spread quickly and by 1971 PLCs were being used to provide relay replacement in many industries.

Over the years, PLC technology began to incorporate math functions, analog signal processing, and PLC to computer communication capabilities. Due to the harsh environments that these devices were implemented in, the hardware associated with input and output points evolved to rock solid reliability.

Through technological advances PLC based systems are still sufficient for many applications today. Unfortunately, due to memory, speed, and available functionality limitations they are not practical for today's information based control systems. System integrators wind up providing PLC based control systems that rely on PC based systems for critical decision processes. Once you realize that the PC of the system is perfectly capable of executing both control and decision requirements simultaneously, you begin to wonder if the PC is actually serving a purpose in these systems.

3.1.1 PLC Usage Limitations

One of the original primary attractions to PLC usage in control system development was a belief that all maintenance engineers understand ladder logic programming. This belief persists today. Unfortunately, the reality of it is that block transfer data functions required for more complex operations are quite difficult for seasoned electrical engineers to translate much less maintenance level personnel. This is primarily due to the fact that functions of this nature are almost impossible to depict in a ladder diagram format. As a result, the overhead associated with the implementation of these functions is quite cumbersome.

Another problem associated with PLC usage is the fact that the syntax of the ladder programming language makes it difficult for engineering firms to re-use source code from project to project. PLC code re-use requires the user to manually re-type I/O and internal bit addresses. This limitation makes product evolution for a particular industry very difficult to accomplish. In effect, engineering firms are forced to re-design the wheel to a certain extent for each project.

3.2 Networked Micro-Controllers

The mechanical aspect of environmental control equipment has become quite complex over the years. NH3 screw compressors for instance are far more complex than their reciprocating predecessors. The units are in fact so complex that they typically require a dedicated computer based control system or micro-controller. Equipment manufacturers began providing these MICRO units with more complex mechanical devices in the early 80's. Much like PLCs, these MICRO units have evolved into very reliable solutions for small area control.

Many equipment manufacturers who also provide full-blown environmental control solutions are currently utilizing networked MICRO units as an overall control system. These systems usually include a generic HMI package implementation to provide users with a cohesive overview of the entire system.

3.2.1 Networked Micro-Controller System Limitations

Unfortunately, the micro-controllers commonly provided by equipment manufacturers tend to utilize proprietary hardware and software design concepts. Proprietary equipment concepts are impractical in a large facility that utilizes equipment provided by multiple manufacturers.

Another problem with this form of system is the fact that the vendor typically chooses to retain ownership of the source code created for the project. In effect, this means that the end-user is forced to rely on the vendor for all future enhancements. Under this scenario, even simple modifications can quickly become costly endeavors.

3.3 Generic HMI

As more and more PLC based systems were implemented, the systems that they controlled became more complex. In a short period of time it became apparent that some form of Human-Machine Interface or HMI would be required. Several generic software application suites began to appear on the market to develop these interfaces. Today, products such as Wonderware or Allen Bradley's RSView system have become commonplace in plant floor operations. These products can be used to develop very intuitive graphic user-interfaces to simplify plant floor operations.

3.3.1 Generic HMI Limitations

While these products are quite useful one has to remember that they are designed and developed to suit the needs of all industrial implementations. The functionality that can be provided in systems developed using these products is limited to the functionality that is provided in the application suite itself. If the application suite does not support a particular system requirement, the customer is forced to either develop a new plant-floor procedure or pay someone to develop a proprietary software solution to handle the process. In many cases, end-users are forced to alter their various business processes to suit the limitations of the application suite.

4 SST History

LOGIC Technologies was founded in 1980 by Gordon Simpson. While the organization provides other types of control systems, the primary focus has always been to provide reliable environmental/refrigeration control solutions. Gordon realized in a short period of time that PLCs would be impractical for these systems due to the analog signal and historical information data processing requirements. PLC/HMI solutions could be implemented; however, the resulting system would be limited to the functionality of the HMI application suite utilized. In order to solve this problem, Gordon and his associates began developing a design methodology that would provide a cost-effective reliable solution with no functional restrictions. The end-result came to be known as *Signal Server Technology* or SST.

Signal Server Technology is simply a method of interfacing real world signals into a network environment. The system allows for plant wide system control and can be custom configured for each customer's specific needs. The dbc/OS32+ operating system provides drivers to monitor/control standard PLC I/O rack component systems produced by all major manufacturers (AB, GE, Opto22, Koyo, etc…). The operating system and associated refrigeration control software has evolved over the years to become a product that can be configured to literally handle anything a customer may wish to do with an environmental control system.

LOGIC Technologies, Inc. has now been providing plant floor automation solutions on an international scale for over 25 years. Fortune 500 clients throughout the United States, South America, and the Pacific Rim rely heavily on the quality and durability of our systems to maintain their respective daily operations. Although we are happy to provide standard PLC-based control systems upon request, to date more than 350 SST systems have been successfully implemented.

5 Advantages of SST Utilization

The LOGIC Technologies, Inc. SST refrigeration control system was developed specifically for refrigeration control systems and is based on the knowledge and experience of the end-users who utilize the systems, the refrigeration contractors who help to implement the systems, and our own people. As previously stated, the current system represents over 25 years of development. This being the case, the core system provides functionality that simply can't be replicated using standard PLC/HMI development platforms. In effect, custom programming procedures that would be required in a PLC or MICRO based system are replaced by simple site-specific configurations.

It would be quite difficult to describe all advantages gained through the use of the SST system in a single document; however, this section of the document provides a brief overview of some of the more advantageous features. It should be noted here that all features and control algorithms provided by the SST system have been successfully implemented at numerous facilities.

5.1 Standard Refrigeration Control System Advantages

This section of the document lists a few of the advantages that customers gain through the standard features that are included with the implementation of each SST system. A few of the features listed require additional hardware; however, the software required to implement all features listed is included in the standard system.

- **User-Definable I/O Configuration**

  The input and output definitions of the system are stored in a signal database. Tools are provided on the user interface screens to allow authorized users to quickly modify and/or add system digital and analog I/O points. A trained operator can accomplish system enhancements that require additional I/O points or even racks with little or no assistance. A system can even be setup to communicate with I/O rack chains provided by multiple manufacturers simultaneously since the drivers for most available PLC racks are included with each system.

- **Windows Based GUI Client System**

  Each SST system sold includes a site license for the Logic Technologies, Inc. ECON client application suite. This LAN based tool is a Microsoft Windows based application suite that can be installed on any Windows based PC affiliated with the facility. The application provides full access to the control screens that are available on the SST server system control panel. The client application suite also provides advanced graphic screen creation tools and data collection capabilities for the system.

- **User-Definable Statistical Screens**

  The ECON client application suite provides simple to use tools that were developed to allow a user to define graphic displays for system monitoring and control purposes. The toolset includes common drawing tools along with the necessary tools to quickly associate graphic objects with SST server and I/O events.

- **User-Definable Alarm Configuration**

  SST systems are initially implemented with a rich set of alarm condition notifications. The user interface also provides tools to allow authorized users to define new alarm condition monitors and notification methods.

- **Screw Compressor Communication Drivers**

  The core system includes communication drivers to communicate with the screw compressor micro-controllers of all major manufacturers. This feature allows the end-user to add compressors in the future from the vendor of their choice since the control system is vendor independent.

- **Control System Open Source**

  The control programs are developed using a simple script language. The ECON client application suite provides all tools required for operational experts to modify/create and deploy programs and procedures.

- **Manual I/O Control Overrides**

  The I/O display screens of the system allow an authorized user to temporarily override the automated control of system outputs to control solenoid valves, motor starters, etc… manually.

- **User-Definable Control Processes**

  SST systems are implemented on a logical mechanical system component level. The user interface provides screens to allow authorized users to define control procedures based on the logical components of the system.

- **Remote 24/7/365 Support**

  LOGIC Technologies provides technical support on a 24/7/365 basis with each system. This remote support is accomplished with tools built into the ECON client application suite. The engineers that develop the systems provide the support. The customer's authorized personnel can also use the support tools provided from a remote location.

- **Monthly Training Sessions**

  LOGIC Technologies conducts in-depth training sessions at our facility on a monthly basis. Two free sessions are included with each system. Additional training sessions are available on a long-term basis for a nominal fee.

- **User-Defined Reporting System**

  Each system implemented provides a rich set of predefined reports. In addition to the standard reports provided, the system provides tools to allow authorized users to quickly create custom reports that reflect the plant's daily operations and procedures.

- **Advanced Graphic Trending**

  Long-term historical information is stored for analog values utilized by the systems. Screens are made available to allow the user to view the detailed analog values in graphic trend chart form or a standard list.

- **Standard Office Tool Data Extraction**

  The ECON client application suite provides facilities to export report layer information into Microsoft Office tools such as Excel spreadsheets for further analysis and formatted reports.

- **Integrated Preventive Maintenance Tools**

  The "Preventive Maintenance" package is sold as an option; however, once installed the maintenance tools are fully integrated with the control system. This option can be added at anytime in the future with the same seamless integration. The package provides all tools necessary to implement an automated preventive/scheduled maintenance system. Once implemented, the system will schedule, track, and report maintenance operation procedures based on runtime statistics of the mechanical system.

- **Supervisory Graphic Analysis Tools**

  The ECON client application suite provides tools to allow a user to define HTML pages and associate system values with HTML tags in the pages. HTML versions of all user-interface screens are automatically

generated on demand by default. The application suite can be used to serve the pages on demand over the Internet or the customer's intranet. In effect, this functionality provides the ability to provide WEB-based statistical analysis snapshots of the system to remote users on demand.

- **Alarm Signal Telephone Notification**

  One of the newest features added to the system allows the system to notify key personnel of alarm conditions via telephone. This feature utilizes voice synthesis technology to call specific users (defined for each relevant alarm) and inform them of critical system alarm conditions that must be dealt with.

- **SMTP Text-Messaged Alarm Notification**

  The SST system provides the functionality required to send text-message alarm notifications via SMTP email procedures. This feature utilizes the customer's SMTP server to notify specific users (defined for each relevant alarm) when critical system alarm conditions exist that must be dealt with.

5.2 Power Management Features

Most modern refrigeration system facility designs include heavy usage of variable frequency drive or VFD technology. Properly implemented VFD motor control procedures can equate to substantial energy-cost savings for the end-user. The built-in power-management features of the SST system can dramatically simplify the facility-wide configuration and long-term energy cost-saving planning involved with the implementation of VFD or modulated valve technology.

Listed below are a few of the many power-management features provided by the SST system. As you review the list it's important to remember that to take full advantage of the energy saving capabilities of the system a KWH meter is required from the power company.

- **Individual Component and Overall System Energy Consumption Monitor Capability**

  The system allows users to monitor the energy consumption of individual refrigeration equipment components in real time. Users can also monitor the energy consumption of the entire system at once. Historical energy consumption information is also stored to allow users to view the energy consumption trends of individual components or the entire system over time. The information can be reviewed locally or from a remote site.

- **Detailed Energy Consumption Reports**

  The system provides detailed energy consumption reports that can be used to fine tune the parameters of the system to ensure that the refrigeration equipment is operating at maximum efficiency. The system also provides the tools required to allow a user to define custom reports for management review.

- **Unlimited Engine Room Schedule Configurations** (seasonal, product load, etc…)

  The system provides the functionality required to allow a user with the proper security clearance to create unlimited compressor schedules. This capability allows the customer to configure lead-lag compressor start sequences to compensate for large product loads that are expected or seasonal requirements due to ambient temperatures. The schedules are configured based on day of week and time and are automatically engaged.

- **BRTI (Blast Run-Time Interval) Control Schemes** (optimal evaporator efficiency)

  The BRTI or Blast Run-Time Interval feature was originally developed for blast freezers; however, the feature can be used on all evaporators in the system to improve operational efficiency. This feature provides up to three defrost intervals for valve groups thus allowing the customer to configure defrost cycles to compensate for specific product requirements or load factors. Proper use of this feature can guarantee 100% efficiency by guaranteeing that the evaporators are operating with a clean coil.

- **Temperature Setback Scheduling**

  The temperature setback scheduling feature of the system allows the customer to create automatic time of day / day of week set-point schedules for the evaporators. The schedule capabilities can be used to reduce overall KW consumption by turning off equipment during peak power charge periods. Reduced equipment requirements obviously equate to reduced compressor runtime requirements.

- **Proportional VFD Compressor & Temperature Control**

  The standard refrigeration control system provides the capability to control fan and compressor motors using VFD controllers. The additional up-front costs of the VFD controllers can quickly be recovered through energy cost savings. Once temperature set-points are achieved the temperatures can be maintained utilizing various equipment motors running at a reduced speed. When VFD controllers are provided the speed of various motors associated with the refrigeration equipment are automatically reduced. Motors operating at reduced speeds require far less power.

- **Shed Load by Demand Power Features**

  The scheduling capabilities of the system related to evaporators and compressors can be configured to minimize power consumption during peak charge per KWH times. Lead-lag compressor and evaporator fan run sequences can be based on power consumption.

- **Overall Consumption Based Coherent Control Algorithms**

  The underlying philosophy behind the entire control system is to achieve the required set-points using the least amount of power equipment possible. This being the case, the customer can quickly configure new equipment in the future to operate at maximum efficiency. The component based control scheme makes it possible for a user with the proper security clearance to configure new compressors, valve groups, etc… in just a few minutes.

- **PID Based Vessel Liquid Level Control**

  This control scheme eliminates pressure fluctuations that normally result from pulses of liquid being fed into a vessel with standard open/close solenoid valve types. This is accomplished by controlling the flow using modulated valves. Pressure fluctuations result in unnecessary compressor start/stop operations.

- **“Floating” Head and Suction Pressure Control Schemes**

  Controlled variance of the head pressure based on ambient wet-bulb temperature allows the system to maintain the lowest possible system discharge pressure. Controlled variance of the system suction pressure set-point allows the system to maintain temperature requirements at the highest possible suction pressure. Higher suction pressures and lower discharge pressures equate to reduced compressor work loads.

6 Competitor Myths

Unfortunately, many of our competitors attempt to persuade customers to select a conventional PLC/HMI or networked MICRO design specification using unfounded statements. These statements are perpetrated through a lack of understanding of the systems that are actually provided by LOGIC Technologies, Inc. This section of the document is therefore provided to dispel these “Competitor Myths”.

6.1 Myth # 1: LTI Provides Proprietary Software Systems

Many of our competitors would like for you to believe that the software systems provided by LOGIC Technologies, Inc. are proprietary in nature. This is definitely not the case. The system was developed specifically for refrigeration control systems based on the knowledge and experience of the end-users who utilize the systems, the refrigeration contractors who help to implement the systems, and our own people. The

refrigeration contractors who install these systems and the end-users who rely on these systems are heavily involved with the evolution of the core functionality. When a need is defined, a solution is quickly designed, developed, thoroughly tested, and released to the end-user community.

The end-user community referenced above includes the WAL*MART organization. The system is utilized to control the refrigeration equipment processes in all WAL*MART distribution facilities. WAL*MART made the decision to specify the LOGIC Technologies, Inc. system several years ago. Like many of our customers, WAL*MART realized that although many control vendors claim to provide open-architecture systems, the LOGIC Technologies, Inc. SST system is the only product available that actually adheres to the specification. SST allows the WAL*MART engineering department to utilize refrigeration and control equipment from all available manufacturers simultaneously.

6.1.1 Open-Architecture Characteristics of SST

The open-architecture term is more than an industry buzzword, it actually is a specification. The following definition is provided by "WebOPedia" @ http://www.webopedia.com/TERM/O/open_architecture.html.

"An architecture whose specifications are public. This includes officially approved standards as well as privately designed architectures whose specifications are made public by the designers. The opposite of open is closed or proprietary."

LOGIC Technologies, Inc. SST systems definitely adhere to the specification. All system specific source code is provided to the end-user along with a robust interactive development environment that can be used to further enhance the system. The systems are implemented on a logical mechanical system component level. The user-interface provides screens to allow authorized users to define control procedures based on the logical components of the system.

The input and output definitions of the system are stored in a signal database. Tools are provided on the user interface screens to allow authorized users to quickly modify and/or add system digital and analog I/O points. A trained operator can accomplish system enhancements that require additional I/O points or even racks with little or no assistance. A system can even be configured to monitor and control I/O rack chains provided by multiple manufacturers simultaneously.

The standard system provides functionality to implement all common procedures related to environmental control processes through simple graphic screen based configurations. The actual control programs are developed using a simple script language. If actual control level algorithms require modification or additional functionality (highly unlikely), the eCON client application suite provides all tools required for operational experts to modify/create and deploy programs or procedures.

6.2 Myth # 2: Computer Controlled Systems are Unreliable

Many of our competitors have attempted to utilize standard desktop computers to control plant floor operations in the past. Due to the harsh plant-floor environment, standard desktop computers do tend to fail at the hardware level. Unfortunately, their historical failures have perpetrated a myth that computer controlled systems are unreliable.

LOGIC Technologies, Inc. uses industrial grade controllers for plant-floor control. These machines include features such as passive backplane motherboards, anti-shock mounted drive assemblies, fan-less CPU, Compact Flash backup capabilities, and dust-tight enclosures. In effect, all points of failure associated with standard desktop computers have been eliminated. The flash ram capabilities of these machines and the small footprint of the dbc/OS32+ operating system make it possible to recover from a catastrophic hard drive failure

in a few seconds. The controller can boot and be run on the flash ram for several days with no visible performance degradation. Once the hard drive has been replaced the system files can be restored to the drive from the flash ram while the system is running.

As a further precautionary step, LOGIC Technologies, Inc. mounts the industrial controller and all communication components in a NEMA 12 enclosure and powers the equipment through ferroresonant UPS/power regulators. The ferroresonant UPS replaces the buck-boost portion of a line interactive UPS with a ferroresonant transformer to provide a higher degree of power conditioning of the line power for the downstream devices. A controller illustration and specification list is provided below for further clarification.

SST Controller: Specifications:

- Industrial PC Chassis
- Passive Backplane
- Pentium CPU Daughter-Card
- 128MB Compact Flash Backup
- Standard 80GB IDE Hard Drive
- Communication Multiplexer (8 port)
- 15” LCD Monitor w/KB & Mouse
- dbc/OS 32+ Real-Time Operating System
- Drivers For All Common Communication Protocols
- Simultaneous Control of Opto22, Koyo, AB, and/or GE Industrial I/O Racks
- 750 Watt Ferroresonant UPS

7 Cost Comparison

As previously stated, PLC based designs force engineering firms to re-invent certain standard procedures on each project. Networked MICRO systems are comprised of proprietary programs created for specific areas or devices in a facility. Unfortunately, special programs are typically required for MICRO based systems for equipment that is manufactured by a different vendor. Since SST systems are evolutionary in nature the vast majority of engineering overhead that is typically associated with plant floor control system development is eliminated through simple site-specific configuration settings. Reduced engineering man-hours equates to a lower cost for the end-user.

Generic HMI package licenses are sold based on tag (I/O counts) and the number of computers requiring access to the system. Needless to say, the required licenses for large complex systems can become extremely expensive. The SST ECON client application suite is provided as a site-license for each facility. End-users can install the package on all machines associated with a facility without incurring additional costs. The ECON application suite provides all functionality provided with generic HMI packages along with many powerful features that simply aren't available in generic packages.

Since SST systems utilize industry standard I/O racks the cost difference from a hardware standpoint is insignificant; however, SST systems can utilize I/O structures from all major manufacturers so the end-user can select lower priced I/O equipment. The point here is that the reliability of I/O rack equipment is quite high for all manufacturers since they all basically use the same electronic components. Reliability differences are usually related to the actual PLC module which isn't used in an SST system. For instance, KOYO I/O components are far less expensive than their Allen-Bradley counterparts but the reliability factor from a pure I/O standpoint is about the same. For retrofit systems, the SST controller can be used to control existing I/O structures manufactured by any standard vendor. This feature dramatically reduces the field-wiring costs typically associated with control system upgrades.

8 SST Ease of Use

The graphic user-interface of the SST system was designed for use by refrigeration engineers. All screen references and operations are represented by refrigeration equipment components and terms. The ECON client application suite includes all tools required to create new user-interface screens. An experienced user can quickly create an intuitive user screen based on a bitmap image with a few mouse clicks.

Lanier Technical College located in Oakwood, GA provides an accredited ammonia refrigeration training program. Lanier utilizes the LOGIC Technologies, Inc. SST control system in their refrigeration lab. The refrigeration component based user-interface of the system allows the instructors to concentrate on refrigeration principles. Students in turn can gain a basic understanding of refrigeration control principles and terminology by simply utilizing the screens provided.

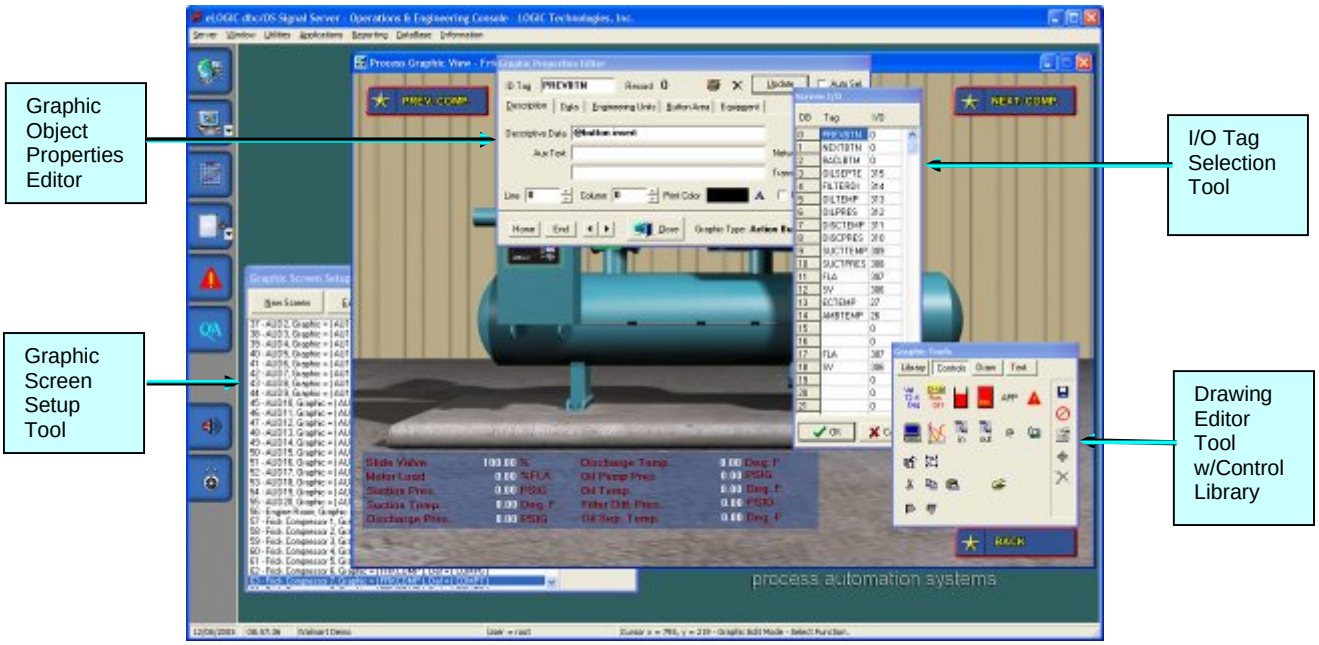
8.1 ECON Client HMI

The LOGIC Technologies, Inc. ECON client application suite includes all functionality available in generic HMI packages plus a wealth of functionality that does not exist in generic packages. Generic HMI platforms require a license fee for each user station. A site license for the ECON client application suite is provided with each SST system implementation.

As previously stated, the graphic user-interface of the ECON application suite was designed for use by refrigeration engineers. This being the case, all screen references and operations are represented by

refrigeration equipment components and terms. The ECON client system provides all tools required to design, develop, implement, and utilize comprehensive operator interface screens. Users with the proper security clearance can quickly develop interface screens using the user-friendly graphic tools provided. Screens can be developed using a variety of sources as a graphic base (standard bitmap images, digital photographs, AVI or MPG video stream, live network camera video stream, etc…).

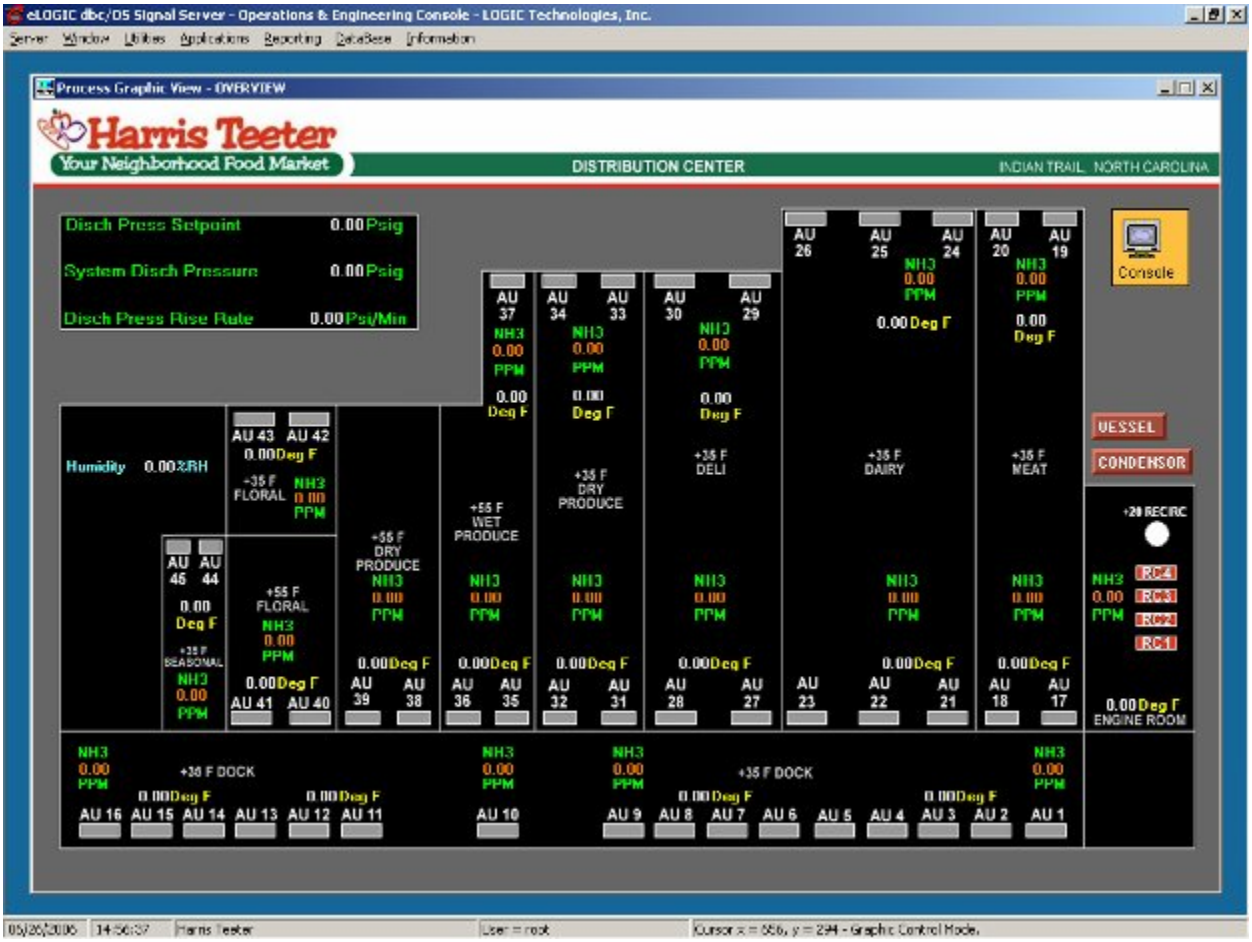
Tools are provided to allow a user to edit and/or create bitmap base images. Labels and their associated signal resources are selected and placed on the graphic base using simple drag and drop methods. The ECON client suite also includes a built-in WEB server. The system automatically creates HTML/PNG representations of each graphic screen developed. Upon demand, the WEB server will update the representations with current system statistics and deliver them to the Internet or the customer's intranet. The following illustration is provided to further clarify the tools provided and their use.



All graphic user interface screens produced by Logic Technologies, Inc. are rendered using the AutoDesk 3D Studio package. It should be noted here that certain user interface screens are implemented in a text based fashion. Text-based screens are provided when a graphic version of the screen would over complicate the operation in question. The following screen illustrations should be considered typical of a Logic Technologies, Inc. SST system.

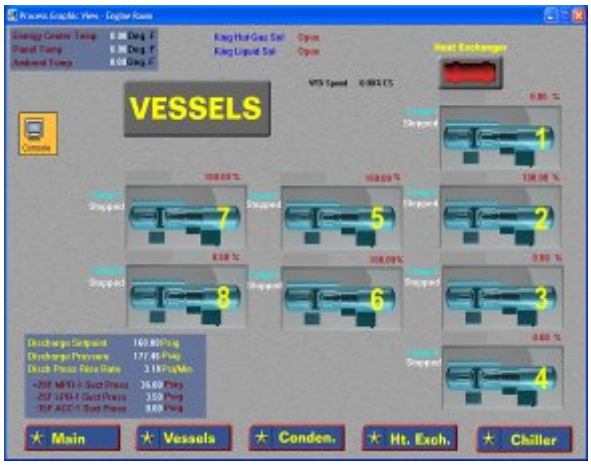
Note:
The “Harris Teeter” emblem embedded in the following illustrations is a registered trademark of the Harris Teeter Corporation. The screens were captured from an existing system in order to demonstrate the actual screens that are provided to end-users.

Graphic System Overview



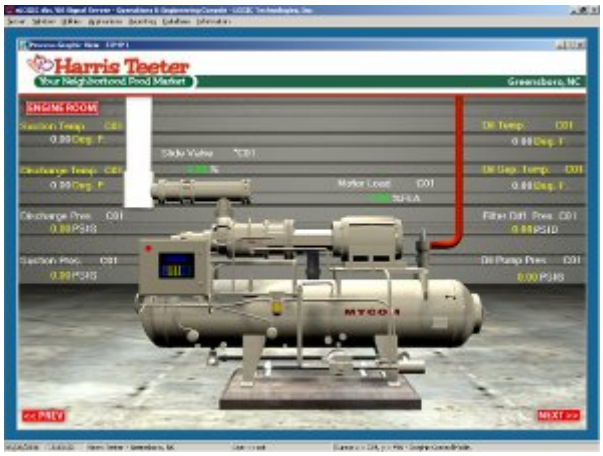
The system overview provides real-time general system statistics for the plant floor. The overview screen provides links to more detailed area and/or refrigeration equipment-level graphic screens. Screen based pushbuttons are provided on all screen types when necessary to allow the user to execute certain system level functions.

Typical Area Graphic Screen



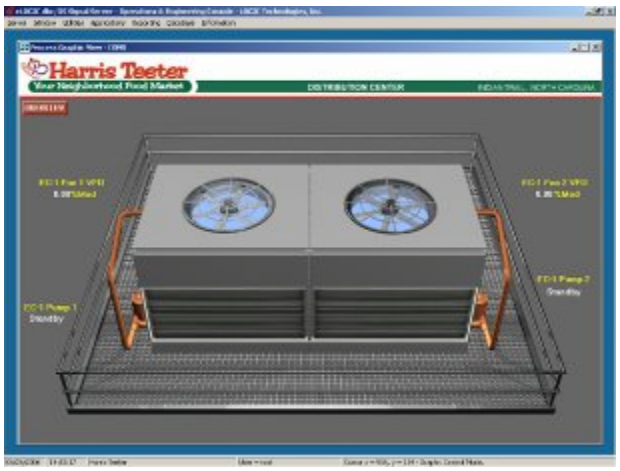
Area overview screens are similar to system overview screens. They provide real-time general system statistics for the referenced area. Links are provided to more detailed refrigeration equipment-level graphic screens.

Compressor Detail



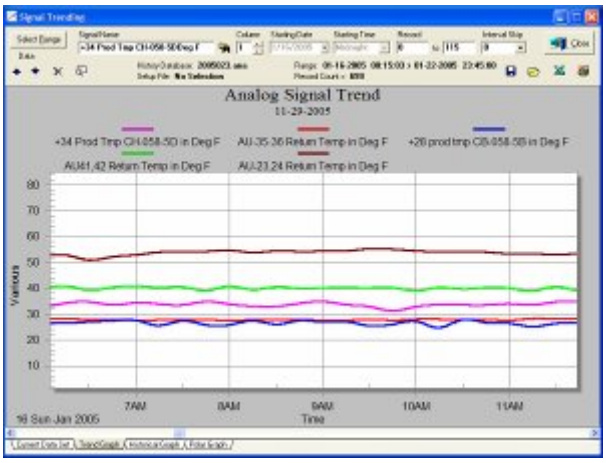
All statistics displayed on the detail refrigeration equipment graphic screens are updated in real-time.

Condenser Detail



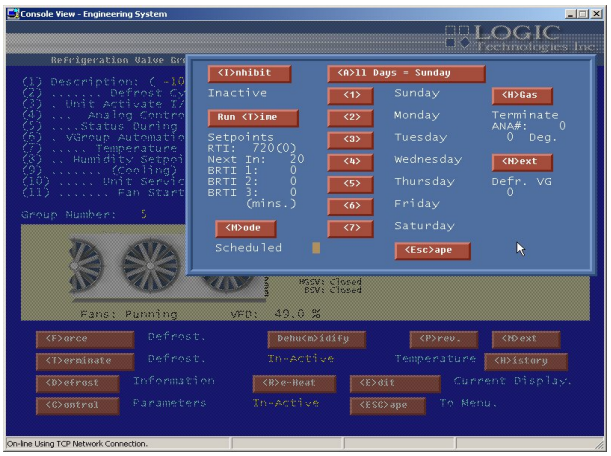
Components such as fan units are animated whenever possible.

Typical Analog Trend Screen



As depicted above, analog trend screens are user selectable and definable.

Typical Text-Based Screen



9 Product Support

The code re-use limitations of PLC/HMI based systems described in section 3.1.1 above make the systems very difficult to support. The source code related to networked MICRO solutions is typically owned and maintained by the controls vendor. This being the case, the end-user's personnel can provide very little assistance in the trouble-shooting process. In either case, a technical support representative is forced to research and translate the nuances of each system's source code to provide a viable response to system issues. Since the majority of the systems produced by LOGIC Technologies, Inc. are SST based, technical support representatives essentially support one software product that has been configured for many facilities. Diagnosis of setup parameters obviously requires far less time than translating site specific source code.

9.1 Service After the Sale

Each system implemented by LOGIC Technologies, Inc. includes 1 year of unlimited 24/7 telephone support services. The 1 year period begins on the date that the end-user obtains beneficial use of the system.

In the unlikely event that an on-site support call is required during this period due to demonstrable defects in the system, a technician will be promptly dispatched to the site. It should be noted here that on-site support calls made due to operator error or mechanical equipment failures will be billed @ $650 per day plus expenses. The final billing determination will be made by LOGIC Technologies, Inc. All on-site service calls made beyond the initial 1 year warranty period will be billed @ $650 per day plus expenses.

Annual system upgrades are offered to our customers for $860. The annual upgrade fee includes an additional year of unlimited 24/7 telephone support services.

10 Decision Matrix

This section of the document was created to provide the reader with a quick summary of the benefits that can be gained through the use of SST. All decision matrix items listed in the table below are described in the document content of sections 1 through 9 above.

Feature Description	SST	PLC/HMI	MICRO Units
Core System Developed Specifically for Environmental Control	Yes	No	Partially
Reliable Controller and I/O Structure	Yes	Yes	Yes
True Open-Architecture Design Base	Yes	No	No
Cost-Effective Solution	Yes	No	No
Evolutionary Functionality	Yes	No	Some
Intuitive Refrigeration based GUI	Yes	No	Vendor Dependent
Time-Tested Refrigeration Control Algorithms	Yes	No	Vendor Dependent
Functional Limitations	None	Many	Many
Operator Training Requirements	Minimal	Extensive	Extensive
Maintenance Level Training Requirements	Minimal	Extensive	Extensive
Potential for Return On Investment through standard features	High	Minimal	Some
Extended User Community	Yes	Hardware Only	No
Corporate and Product Longevity	Yes	Vendor Dependent	Vendor Dependent
Problem Diagnosis and Resolution Time Requirements	Minimal	Extensive	High
User Definable I/O Configuration	Yes	Yes	No
Comprehensive Windows Based GUI Client System	Included	Optional	Optional
User Definable Statistical Screens (Tools)	Included	No	No
User Definable Alarm Configuration	Yes	No	No
Screw Compressor Communication Drivers	All Included	Site Specific	Vendor Dependent
Control System Open Source	Yes	Yes	No
Manual I/O Control Overrides	Yes	Yes	No
User Definable Control Processes	Yes	No	No
Remote 24/7/365 Support	Included	Vendor Dependent	Vendor Dependent
Monthly Training Sessions	Yes	Vendor Dependent	Vendor Dependent
User-Defined Reporting System	Included	Optional	No
Advanced Graphic Trending	Included	No	Vendor Dependent
Standard Office Tool Data Extraction	Included	Optional	Optional
Preventive Maintenance Tools	Option	No	No
Supervisory Graphic Analysis Tools (Internet or LAN)	Included	No	No

P.O. Box 189 -117 Bellamy Place - Stockbridge, Georgia 30281 - Phone (770) 389-4964 - Data/Fax (770) 389-4871

Feature Description	SST	PLC/HMI	MICRO Units
Alarm Signal Telephone Notification	Optional Hardware	No	No
SMTP Text-Message Alarm Notification	Included	No	No
Individual Component and Overall System Energy Consumption Monitor	Included	No	No
Detailed Energy Consumption Reports	Included	No	No
Unlimited Engine Room Schedule Configurations	Included	No	No
BRTI (Blast Run-Time Interval) Control Schemes	Included	No	No
Temperature Setback Scheduling	Included	No	No
Proportional VFD Compressor & Temperature Control	Included	Optional	Yes
Shed Load by Demand Power Features	Included	No	No
Overall Energy Consumption Based Coherent Control Algorithms	Included	Vendor Dependent	Vendor Dependent
PID Based Vessel Liquid Level Control	Included	No	No
“Floating” Head and Suction Pressure Control Schemes	Included	No	No