Appendix

Global User Station
Human Interface Considerations
For a Multi-Windowed System

Introduction

The evolution from a single window Universal Station to a multi-windowed GUS workstation requires a new strategy for display presentation. This must be done while capitalizing on the benefits brought by a multi-windowed, open platform. When developing a Human Interface strategy, there are platform and data environment variables that must be considered. These variables define the performance capabilities of the strategy and as such, define the boundaries of the Human Interface. This document will suggest new considerations for developing a Human Interface strategy in a multi-windowed environment.

Developing a Human Interface strategy in a Multi-Window Environment

Process control Human Interface strategies have traditionally been developed around a single window environment. Most industrial processes require multiple views of the process simultaneously, so a console configuration or a cluster of Human Interfaces has been adopted. Displays designed for single window environments, can be high-density presentations that are then distributed on dedicated processors in a console arrangement. The amount of information that is required by the operator and the number of operators, dictate the number of stations in a console.

With the introduction of the Global User Station, (GUS), the Honeywell process control Human Interface has advanced into the Open Technologies environment. GUS is a Human Interface application, which runs on Microsoft NT, and can be optionally configured to run up to four simultaneous displays. There is a tendency, by single window users to view the additional windows provided in a multi-windowed system as an opportunity to present multiple displays that were designed for a single window strategy. A multi-windowed environment should not be viewed as a replacement for the console viewing strategy.

Because the Global User Station is an Open Human Interface on an Open System, it has no limitations on the amount of data that it can request from a network. Therefore, a strategy must be developed to work within the boundaries that are defined by the process performance criteria.

Display Types

This document will discuss three categories of displays. Each has a unique performance requirement that is inherent of its use by the operator. These three display types are Overview, Focused Schematic, and Point Manipulation display.

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Overview Display

An overview display provides a broad view of the process and should be designed to inform the operator of the process status. Process relationships and alarm status would be determined from an Overview Display. This display type is typically called up with less frequency than other display types and may be on the screen for long periods of time. Call up performance should not be as critical for an Overview Display, as it is with Point Manipulation or Focused Process displays.

Focused Process Display

This display focuses on a particular area of a control strategy or unit. It provides additional detail that is not present in an overview display. It will typically be called up in response to an event that has been reported by the overview display and as such, requires a call up performance equivalent to the operator response. These displays will typically not exceed 200 parameters and provide a call up of 2 seconds or less.

Point Manipulation Displays

This display type provides the ability to manipulate a single point. A change zone is a point manipulation display. This display must be very responsive to the operator, usually less than 1 second call up. It will be called up for a short duration and will contain a small number of parameters, typically 5 depending on the point type. This should be a self-contained display and should be capable of being called up quickly, used by the operator, and then closed.

Window Management

With these three display types defined, it is appropriate to address presentation styles. It is important to understand that there must be some kind of window management applied to the Human Interface which considers the number of windows, the display types, and the need for concurrent use. This must be done, of course, in concert with meeting the information needs of the operator. This management can easily be done with the Safeview product and console viewing strategies.

Safeview

Safeview will manage the window environment for a given Human Interface. Display types can be categorized and managed on the screen to control the number of window types that are being used at one time. A typical Safeview workspace may allow one overview display (on a two CRT station, this display could be on the secondary CRT, using the full screen). This overview display would launch a focused process display when the operator is alerted to focus on a particular area by the overview (on a two CRT station, the focused process display could be directed to the primary CRT). From that focused display, a point manipulation display could be launched to allow the operator to make process changes. The CRT (or CRTs) may have a dedicated area for the Native Window to manage alarms and/or diagnose nodes on the network.

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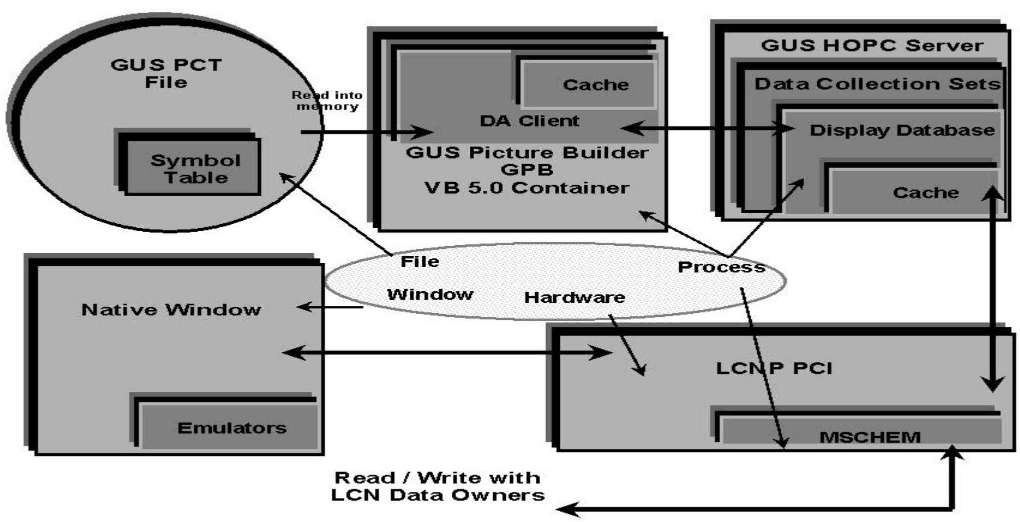
This is only an example to show how Safeview can manage, not only the operator view of the process, but also control the data requests to the network. Safeview used in concert with console configurations allows the strategy to control the process view, display performance relative to density and the information needs of the operator.

Display scripting considerations

A variable that can have a large impact on display performance is display scripting. This subject is discussed in detail in the *GUS Display Tutorial*. This document is a "must read" for building displays and details the scripting "do's and don'ts" for display performance. This document must be understood before proceeding with the construction of any displays. It is also helpful to understand the data flow patterns within the GUS architecture. Reference Figure 1 for a graphical representation of this data flow architecture.

Figure 1



It is important to note that the data cache of the HOPC Server is where data is compared for "on data change" scripts. The collection groups retrieve data from the data owners at the configured frequency. This data is stored in the cache of HOPC. Each scanned value is compared to the previous scanned value. If the data is different, it is reported to the cache of the running display as a data change. The "on data change" scripts run when the data changes. The data for this script is retrieved from the cache of the display running in memory. This means that all data retrieved from "on data change" scripts will come from memory and not from direct reads to the data owner. Other event types do immediate reads from the data owners. Impact of particular event types is summarized in Table 1.

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Table 1 – Event Type Impacts

Event or Event Type	Cached Read	Immediate Read	Immediate Write
OnDisplayStartup		X	X
OnDataChange	X		X
OnPeriodicUpdate	X		X
OnDisplayShutdown		X	X
User Events		X	X

It should be noted that "on data change" scripts will provide better display performance. Other display scripting constructs are useful but will come with a cost relative to display performance. "OnDisplayStartup" scripts will provide functions at startup, but will also do immediate reads and thereby impact call-up times. "OnPeriodicUPdate" scripts are provided for functions like animation. This script will execute twice a second and will increase CPU loading. This must be managed very carefully. If this script is used, be aware that other parts of the display may be impacted. "OnDisplayShutdown" scripts have the same effect as "OnDisplayStartup" scripts. Thus it may take longer to close a display. "UserEvents" will do immediate reads and writes, as you would expect. But it is important to manage the number of parameters that are immediately read with this type of script so as not to negatively impact performance.

Performance Benchmark

In general, when developing a Human Interface strategy, determine the performance criteria first. Check these criteria with the Honeywell performance benchmark guidelines:

1- A highly complex display with 200-300 parameters (providing typical process display dynamics, including change zones, alarm handling and error handling) is expected to have a call-up time of 2-3 seconds on a Pentium II, 266 MHz platform.

2- A highly complex display with 500-600 parameters (providing typical process display dynamics, including change zones, alarm handling and error handling) is expected to have a call-up time of 4-5 seconds on a Pentium II, 266 MHz platform.

3- A highly complex display with 800-1000 parameters (providing typical process display dynamics, including change zones, alarm handling and error handling) is expected to have a call-up time of 6-8 seconds on a Pentium II, 266 MHz platform.

From these guidelines, determine the number of parameters per display that will meet the performance criteria.

Variables and Boundaries

When developing a Human Interface strategy, there are also platform and data environment variables that must be considered. These variables define the performance capabilities of the strategy and as such, define the boundaries of the Human Interface. Additionally, a Human Interface strategy must manage the rate in which data is requested, while maintaining the capacity to have access to all of the data.

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CPU clock speed is an obvious variable that will impact performance. This document will discuss variables that are generic to the processor. Therefore, relative to processor types, it is enough to say that the faster the clock speed of the processor, the higher the performance capabilities.

Random Access Memory, RAM, is an important variable to consider for individual stations. Because NT pulls applications into memory for processing, this platform variable can increase a station's performance relative to display complexity and the number of windows. Recommendations for RAM are 64 MB for a single display configuration and 128 MB for multiple displays and/or large single displays. Another factor that must be considered in determining the amount of RAM, are other applications that may run simultaneously with GUS displays. The memory requirements of these applications must be considered when sizing your workstation for RAM.

Hard drive size is another variable that should be considered. After a GUS hard drive has been loaded with Microsoft NT, the GUS application and software options, there is approximately 700 MB of drive space used. This is without any displays being built. A full, or near full disk can cause fragmentation of the files. Never allow your hard drive to become full. A hard drive with file fragmentation will yield a slow Human Interface. A hard drive, that is over 70% full, should be managed and logical file distribution should be applied. A two GB hard drive is recommended. It is also recommended that for every software upgrade or new application installation, the hard drive should be defragmented. There is third party software that will provide this utility.

Virtual memory or Page file size should be configured to equal three times the amount of memory. This will allocate hard drive space and this space cannot be used for other file storage. Workstations with large memory will require much larger disk space to accommodate virtual memory. It is also important to note that the page file size should not be configured to grow, i.e. the minimum and maximum size should be equal. If you enter a minimum and maximum that are different, you are allowing NT to grow the virtual memory and this will cause page file fragmentation. This too, will slow down the Human Interface.

Video board memory size has an impact on display performance. There are three parameters that must be configured in the desktop settings. They are color palette, desktop area and refresh frequency. These settings are limited by the amount of video board memory. A video board with 2 MB per CRT will require a choice between high color, 65,536 colors, and high-resolution, 1280x1024 pixels. Honeywell tests indicate that the Native Window performance will be best in the high color configuration. A 4 MB per CRT video board will allow both the color palette and the desktop area to be set high or 65,536 colors and 1280x1024 pixels, respectively. Do not set the colors settings higher than 65K. This will slow down the workstation. A 4 MB video board will also allow a higher refresh frequency. The higher the frequency, the more contiguous the display, i.e. no blips on the screen. All of these settings will effect display performance. Tests have revealed that more video memory will yield faster displays. Honeywell does provide certified video boards with 4 MB of memory as of November 1997.

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Ethernet variables

There are variables that can effect the human interface performance that are outside of the workstation.

<u>Name resolution</u>

The GUS application requires computer name resolution at startup. The GUS data server will not start without it. This means that the computer name and Internet address must be resolved through Domain Name Services or local host files. Honeywell recommends that the local host file be used. This file exists on the hard drive and is available for name resolution whether the network is there or not. DNS would always be off node via the Ethernet. It is also recommended that the GUS node not use DHCP. This provides the Internet address at boot time from a server across the network. In the event that the network is not there, we must have a means to resolve an Internet address and computer name, hence the recommendation for a local host file.

<u>Protocols</u>

The GUS application only requires TCP/IP. Additional protocols can be installed, but you must be aware that if something does go wrong with the Ethernet, NT will investigate through all protocols that are configured. The more protocols installed the more CPU time will be used to investigate. This potentially can slow down the human interface. Honeywell recommends that only the necessary protocols be installed for the network.

Choices

Human Interface strategies must be defined based on operator information requirements and performance criteria. There are station variables, RAM, video memory and hard drive size that can be manipulated to accommodate a strategy. Honeywell has not placed any limits on display size or complexity. The end user must make choices about display density, display complexity and the number of concurrent displays. These choices will determine the performance of the Global User Station. A clear understanding of Display scripting will provide a managed data access strategy and will optimize the RAM and CPU resources. These choices will determine the performance of the Human Interface strategy in a multi window environment.

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Please see the Summary Table for quick reference to the details described in this document.

Summary Table

Display scripting:	Data Access method	Display Performance
OnDataChange	Cached read from memory	Faster
OnDisplayStartup	Immediate read, data owner	Slower
OnDisplayShutdown	Immediate read, data owner	Slower
OnPeriodicUpdate	Cached read from memory	Slower due to CPU usage
Platform Variables	Action	Display Effect
RAM	64 MB – Display Max	Not memory bound
	128 MB – Multiple Displays	Not memory bound
Hard Drive	Increase size, 2 GB minimum	Reduce fragmentation
Video Board Memory	Increase to 4 MB	High color, High resolution
Ethernet Variables	Recommendation	Display Effect
Name resolution	Local Host file	None with Ethernet down
Protocols	TCP/IP only	Minimal with Ethernet down.