TCP/IP Host Protocol

1. Intent and Scope

This document contains details on using the industry standard TCP/IP protocol with the DXI system.

2. Introduction

A MicroComm DXI system can communicate with an external system (referred to as a host) using industry standard TCP/IP protocols. The TCP/IP protocol allows the two systems to exchange command and status messages.

The MicroComm DXI will send status messages to the host to keep it informed about the status of the MicroComm DXI system. For example, status messages will be issued when call requests are queued, when calls are started or ended, or when faults are detected. The host can use these status messages to indicate the status of the system to the operators.

The host will send command messages to the MicroComm DXI to control the operation of the MicroComm DXI system. For example, command messages will be issued by the host to initiate an intercom call, to end an intercom call, to page a zone, and to enable or disable a master station, The MicroComm DXI will process the command messages and perform the appropriate function.

3. Implementation

Each transmitted message using the TCP protocol consists of a short ASCII string. The TCP protocol guarantees that the individual strings, and therefore the messages they contain, are received error free and in the same order in which they were sent.

The message strings consist of a four-character message code followed by a several numbers, each separated by one or more spaces. The messages are not case sensitive. All numeric parameters are sent as ASCII decimal strings (i.e., as a sequence of the characters 0-9). All MicroComm DXI system ID numbers are limited to the range 0-65535 and the value zero is reserved for use as a null ID. A carriage return (ASCII code 13 decimal) is used as a terminating character for the message. These messages are described in detail in a separate document, Host Port Command/Status Messages (IM-MES-DXI-R14.5).

When writing software to decode this string of characters, the user must write the software so that any status strings that are not recognized as valid messages are ignored, since Harding Instruments reserves the right to add new messages at any time. Note that a status message may not be sent as a single packet when using TCP/IP. Thus, the message must be scanned for the terminating character, and once it is found, the user must then decide whether to act on, or ignore, the message.

The MicroComm DXI system may have one or more SAC computers. Multiple SAC computers may be used for distributed processing in large facilities where each SAC computer controls a portion of the entire intercom

system. Pairs of SAC computers may also be used to provide hot standby redundant control of an intercom system. These two uses can also be combined in the same system, resulting in several redundant pairs of SAC computers working in parallel to provide reliable control of a large distributed intercom system.

The MicroComm DXI system also allows for the same flexibility in the host system with which it communicates. The MicroComm DXI can communicate with a single host, multiple hosts, pairs of redundant hosts, or multiple pairs of redundant hosts.

Since TCP relies on the underlying IP protocol for addressing, each SAC computer and each host must have a unique IP address. The selection of IP addresses is not critical if the system is not connected to the Internet, however certain network addresses (ranges of IP addresses) have been set aside for use in private networks or for network testing. Using these addresses will ensure the system does not cause network problems if it is unintentionally connected to the Internet. If the system will be connected to the Internet, then a suitable network address must be obtained from InterNIC, and IP addresses within that network must be used. The addresses allocated for private networks are:

Subnet	Mask	
10.0.0.0	10.255.255.255	(24 bit host addressing, ˜16777216 hosts)
172.16.0.0	172.31.255.255	(20 bit host addressing, ˜1048576 hosts)
192.168.0.0	192.168.255.255	(16 bit host addressing, ˜65535 hosts)

The MicroComm DXI system allows the user to specify the IP address for the SAC computer(s).

The MicroComm DXI uses host ports to represent the logical connections to the external host systems. Each host port has a unique id number and is assigned to a particular exchange (an exchange consists of a SAC computer, or a redundant pair of SAC computers, and its associated I/O devices). Each host system, be it a single host or a redundant pair of hosts, communicates with the MicroComm DXI system through a single host port. When using the TCP/IP protocols for host communications, a host port corresponds to a TCP port on SAC computer, or a pair of TCP ports (with the same TCP port number) on a redundant pair of SAC computers. The TCP port number is a user-defined part of the host port definition.

Again the selection of TCP port numbers is not critical on a private network. However, TCP port numbers 0–1023 are normally assigned by the Internet assigned numbers authority and should not be used. TCP port numbers in the range 1024–65535 should be used. Harding Instruments recommends using sequential TCP port numbers starting at 10000 since these have not been registered for any other application.

When using TCP/IP, the MicroComm DXI SAC computer(s) will operate as servers, and the host(s) will operate as clients. On system startup, the SAC computer(s) will begin monitoring the user defined TCP port for connections from the client host(s).

To begin communications the host must initiate a TCP session to the user defined IP address of the MicroComm DXI SAC computer(s) using the TCP port number defined for the host port which corresponds with this host. As the session is opened, the SAC computer will determine the host's IP address and port number.

After the session has been opened, the SAC computer will begin sending status messages to the host at its IP address and port number through this session. It will also accept and execute commands sent from the host through this session.

For a system with a single host and a redundant pair of SAC computers, the host will open a session to both the main and backup SAC computer (which have different IP addresses) on the same TCP port.

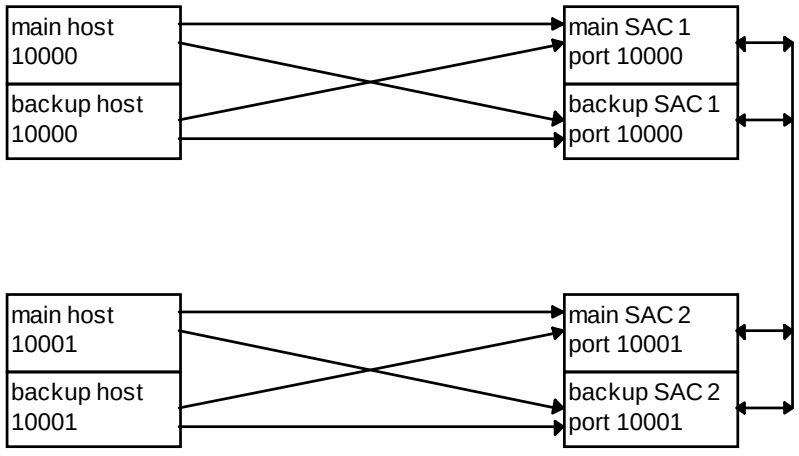
For a system with a single host and multiple SAC computers, the host will open a single session to the SAC computer on which the host port has been defined.

For a system with a redundant pair of hosts and a single SAC computer, both the main and backup host (which have different IP addresses) will open a session on the same TCP port on the SAC computer.

For a system with a redundant pair of hosts and a redundant pair of SAC computer, both the main and backup host (which have different IP addresses) will open a session to both the main and backup SAC computer (which have different IP addresses) on the same TCP port. In this case there will be 4 sessions open.

For a system with a redundant pair of hosts and multiple SAC computers, both the main and backup host (which have different IP addresses) will open a single session to the SAC computer on which the host port has been defined. In this case there will be 2 sessions.

The type and number of sessions in larger systems can be determined by breaking them down into smaller subsystems, which fall into one of these categories. For example a system with 2 redundant pairs of hosts and 2 redundant pairs of SAC computers is shown below.



In order to monitor the communications link for faults both the MicroComm DXI and the host must transmit messages at some minimum rate (i.e. without this, it is impossible to tell if the link has failed or the other party simply has no messages to send when the link is idle). If we know that the other party will send a message every 30 seconds then we can detect and report a communications failure when we have not received anything for some time greater than 30 seconds.

For a system with a single SAC computer and a single host this monitoring is quite simple. Each system simply starts a **monitor transmit timer** when the session opens, resets this timer whenever a message (including the NOOP message) is transmitted, and transmits a NOOP message whenever this timer expires. At the same time, each system starts a **monitor receive timer** when the session opens, resets this timer whenever a message is received, and closes the session and reports a failure when this timer expires. By setting the period of the monitor receive timer to a value larger than the monitor transmit timer we guarantee that the receive timer will be reset continuously as long as the communications link is functioning. The MicroComm DXI lets the user specify the timeout value for the monitor receive timer and monitor transmit timer (NOOP timer) independently.

This mechanism is extended to larger systems with multiple SAC computers and/or hosts with the clarification that the only messages allowed on the inactive sessions are NOOP messages. This allows both systems to monitor the backup links for faults when they are not being actively used, so that these faults can be reported (and the problem corrected) before the system needs to use the backup communications link.

When a host is communicating with a redundant pair of SAC computers, only one of the two SAC computers will be active at any given time. The MicroComm DXI system will indicate which SAC is currently active by sending an ACTV message from the active SAC computer when the session is first opened. The host system should send all command messages using this session unless or until it detects a fault on this session. ACTV messages are only sent upon opening a session; if this computer later becomes inactive (when the redundant computer takes control and becomes the primary computer) then no ACTV messages will be sent during the switchover, instead the PCsw message will be sent.

If the host sends a message, other than NOOP, to the inactive SAC through its session, it will cause the MicroComm DXI system to switch to the inactive SAC computer. The newly activated computer will indicate this to the host by sending an ACTV message.

When communicating with a redundant pair of hosts, the MicroComm DXI system will send all status messages to the session that sent the last command message (other than NOOP). Therefore, the host system should send a message from the active host in the redundant pair to the active, or only, SAC computer to which it is connected. Any message will work, but the ACTV message is recommended. Note, the host must wait until it has received the ACTV message from the active SAC computer before sending its ACTV message when it is communicating with a redundant pair of SAC computers. The active SAC computer will send the ACTV message to both the main and backup host when the sessions are opened. Only the active host will respond with an ACTV message of its own.