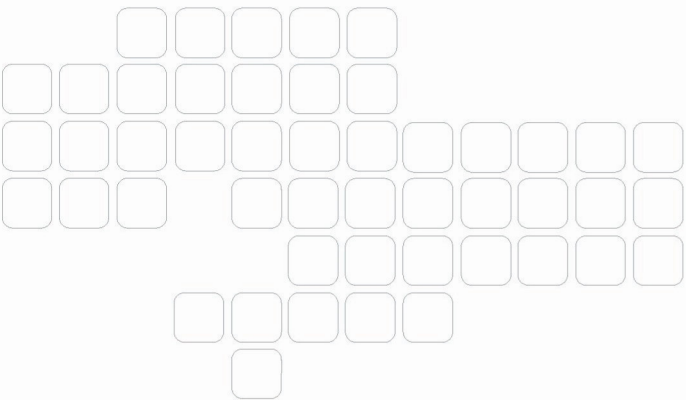
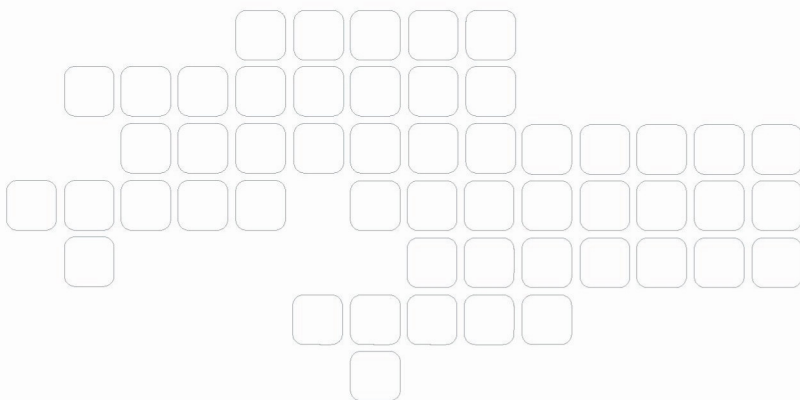




USER'S MANUAL

FireSync Host Protocol

Version 4.11.0.36



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Introduction

This document describes the FireSync®¹ Host protocol. The FireSync Host protocol is a standard protocol based on TCP/IP that allows customers to communicate to a FireSync server or a standalone sensor. Standalone sensors fully implement the FireSync Host protocol, and therefore will henceforth be referred to simply as servers.

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FireSync Host Protocol

Communication Mechanism

A client application operates a FireSync server by sending commands and listening for responses over various command channels. These channels are TCP connections made by the client to predefined ports on the server. Different channels support different groups of commands. Below is a table of these predefined ports.

Channel	Port	Description
System Operation	3190	Core system operation control channel
Management	3191	System monitoring and management channel
Upgrade	3192	System upgrade channel

The commands and replies are sent as binary messages. Each command and reply begins with a header. The general data types are described in the next section, followed by the specification of the headers and commands.

In addition to the TCP command channels, there is a UDP-based broadcast protocol that can be used to set and get the IP addresses of the stations. This can be used on stations with unknown network configurations. It is described in detail in a later section.

Data Types

The command specification uses a shorthand notation for data types. The data type definitions are:

Data Types Name	Description
Char	Unsigned 8-bit character
Byte	Single byte
32u	32-bit unsigned integer
64s	64-bit signed integer
64u	64-bit unsigned integer
type[x]	array of x number of <i>type</i> elements

All numbers are little-endian, i.e. lower order byte has lower memory address, unless otherwise stated.

IP Address

The IP address and subnet mask are represented as arrays of 4 bytes, with the first element corresponding to the first value in the dotted decimal format. For example, IP address 192.168.1.10 is specified as:

```
address[0] = 192  
address[1] = 168  
address[2] = 1  
address[3] = 10
```

Command Header

Each command begins with a header, defined as:

Field	Type	Description
length	64s	Message length in bytes (including header size)
command	64s	Command Identifier

Reply Header

Similar to command, each reply begins with a header, defined as:

Field	Type	Description
length	64s	Message length in bytes (including header size)
command	64s	Command Identifier
status	64s	Status code

The status code is defined as:

Label	Value	Description
Invalid State	-1000	The command failed because it was received during an invalid state. The various system states are described below.
Item not found	-999	The command failed because the requested item does not exist
Invalid Command	-998	The command ID is not recognized
Invalid Parameters	-997	The parameters for the command are incorrect. A parameter could be missing, of the wrong size, or simply have the wrong value.
Failed	0	The command failed
Ok	1	The command was successfully executed

System States

A FireSync system can be in one of several states. The current state of the system determines what commands can be issued to the server. These states are explained below:

State	Value	Description
Idle	1	The system has started up but has detected errors that prevent the system from being able to run.
Ready	2	The system is ready to run.
Running	3	The system is in full-operation mode. The data transfer channel is connected and data is sent when appropriate.
Standby	4	The system is paused. The data transfer channel remains connected and the system is ready to resume immediately.

System Operation Commands

The following is a table of the core system commands. These commands are used in typical sensor operations.

Command	Identifier
Start System	0x1000
Stop System	0x1001
Pause System	0x1002
Resume System	0x1003
Set Operation Mode	0x1004
Get Operation Mode	0x1005
Write File	0x1006
Write Volatile File	0x1017
Read File	0x1007
Delete File	0x1008
Enumerate Sensors	0x1009
Get System Current Time	0x100A
Data Channel Enable	0x100B
Data Channel Disable	0x100C
System Run Command	0x100D
System Ping Command	0x100E
Start Event Channel	0x1010
Stop Event Channel	0x1011
Get System Start Delay	0x1012
Backup Storage	0x1013
Restore Storage	0x1014
Get Server Info	0x1015
Get Sensor Info	0x1016

Start System

This command starts up the system. Upon receiving the command, the FireSync server initiates a TCP connection to the specified TCP end-point (based on *address* and *port* fields). If the connection is successful, the sensor data channel is established and data will be sent on this channel. The sensor data channel is described in a later section.

This command is used to start a system which requires only one data channel. To start the system with multiple data channels, use the enable/disable data channel commands, and the run system command.

Command Message:

Field	Type	Description
header	Command Header	Command message header
reserved[4]	byte	Reserved
address[4]	byte	IP address of data receiving TCP connection

port	64s	Port of data receiving TCP connection
startTime	64u	The start time of the system. Set to 0 to start the system without delay

Reply Message:

Field	Type	Description
header	Reply Header	Command reply header

Return Value:

OK if successful.

Error Value	Description
Invalid state	Returned if the server is in booting or idle state, or a system is already running
Failed	FireSync server cannot establish TCP connection, or if operation failed on more or more sensors

Stop System

This command stops the system. The data TCP connection will be terminated by the FireSync server upon receiving this command

Command Message:

Field	Type	Description
header	Command Header	Command message header

Reply Message:

Field	Type	Description
header	Reply Header	Command reply message header

Return Value:

OK if successful.

Error Value	Description
Failed	If operation failed on one or more sensors

Pause System

This command puts all sensors into standby mode. All light sources (eg. lasers) turn off.

Command Message:

Field	Type	Description
header	Command Header	Command message header

Reply Message:

Field	Type	Description
header	Reply Header	Command reply message header

Return Value:

OK if successful.

Error Value	Description
Invalid state	Returned if the server is not running.
Failed	FireSync server cannot establish TCP connection, or if operation failed on one or more sensors

Resume System

This command resumes all sensors from standby mode. All light sources (e.g. lasers) are turned on.

Command Message:

Field	Type	Description
header	Command Header	Command message header

Reply Message:

Field	Type	Description
header	Reply Header	Command reply message header

Return Value:

OK if successful.

Error Value	Description
Invalid state	Returned if the server is not in standby.
Failed	FireSync server cannot establish TCP connection, or if operation failed on one or more sensors

Set Operation Mode

This command sets the operation mode of the sensor

Command Message:

Field	Type	Description
header	Command Header	Command message header
Mode[16]	char	Name of mode to set

Reply Message:

Field	Type	Description
header	Reply Header	Command reply message header

This command sets the current mode by its name.

Return Value:

OK if successful.

Error Value	Description
Invalid state	Returned if the server is currently running, or in standby
Failed	If the name of the mode is invalid

Get Operation Mode

This command retrieves the name of the currently active operation mode.

Command Message:

Field	Type	Description
header	Command Header	Command message header

Reply Message:

Field	Type	Description
header	Reply Header	Command reply message header
Mode[16]	char	Name of the current mode

Return Value:

This command always returns OK.

Write File

The write file command is used to create a new file or update an existing one on the server. If a file already exists with the given name, it is over-written; otherwise a new file is created.

Command Message:

Field	Type	Description
header	Command Header	Command message header
filename[64]	char	Name of the file to write
fileSize	64s	Size of the file
fileData[fileSize]	byte	File contents

Reply Message:

Field	Type	Description
header	Reply Header	Reply message header

Return Value:

OK if successful.

Error Value	Description
Failed	File could not be updated or created

Write Volatile File

The Write Volatile File command is identical to the “Write File” command, except that the files written are not saved to non-volatile storage; i.e. any new files, or changes to existing files are discarded after power cycling. The distinction exists only for stand-alone devices and sensors. This command should not be used to write files to stations.

It should be noted that, if the “Write File” command is used after “Write Volatile File” commands, then any changes written by the latter are saved to storage.

Command Message:

Field	Type	Description
header	Command Header	Command message header
filename[64]	char	Name of the file to write
fileSize	64s	Size of the file
fileData[fileSize]	byte	File contents

Reply Message:

Field	Type	Description
header	Reply Header	Reply message header

Return Value:

OK if successful.

Error Value	Description
Failed	File could not be updated or created

Read File

This command is used to read the contents of a file from the server. Simply send a command containing the name of the file that is to be accessed, and the server responds with the file data (and length) if the file exists.

Command Message:

Field	Type	Description
header	Command Header	Command message header
filename[64]	char	Name of the file to read

Reply Message:

Field	Type	Description
header	Reply Header	Reply message header
fileSize	64s	Size of the file
fileData[filesize]	byte	File contents

Return Value:

OK if successful.

Error Value	Description
Failed	File could not be read, or file does not exist.
Item not found	File does not exist

Delete File

Send this command to delete a file with the given name from the storage area of the server.

Command Message:

Field	Type	Description
header	Command Header	Command message header
filename[64]	char	Name of the file to read

Reply Message:

Field	Type	Description
header	Reply Header	Reply message header

Return Value:

OK if successful.

Error Value	Description
-------------	-------------

Failed	File could not be deleted
Item not found	File does not exist

Enumerate Sensor

Retrieve a list of sensors currently presented in the system. The number of sensors and their serial numbers are returned.

Command Message:

Field	Type	Description
header	Command Header	Command message header

Reply Message:

Field	Type	Description
header	Reply Header	Command message header
numSensors	64s	Number of sensors present in system
serialNums[numSensors]	64s	Sensor serial numbers

Return Value:

This command always returns OK.

Get System Current Time

Retrieves the number of microseconds since the system is powered up.

Command Message:

Field	Type	Description
header	Command Header	Command message header

Reply Message:

Field	Type	Description
header	Reply Header	Command message header
Current time	64u	Time passed

Return Value:

OK if successful.

Error Value	Description
Failed	The system time could not be read.

Data Channel Enable

Enable an output data channel by providing a channel identifier and a TCP end-point (based on *address* and the *port* fields). The FireSync server will initiate connection to all enabled data channels when it starts.

This command can be processed only when system is stopped.

Command Message:

Field	Type	Description
header	Command Header	Command message header
reserved[4]	byte	Reserved
address[4]	byte	IP address of data receiving TCP connection
port	64s	Port of data receiving TCP connection
channel ID	64s	Between 0 to 63

Reply Message:

Field	Type	Description
header	Reply Header	Command reply header

Return Value:

OK if successful.

Error Value	Description
Failed	The data channel could not be enabled.
Invalid State	The system is not currently stopped

Data Channel Disable

Disable an output data channel. This command can be processed only when system is stopped.

Command Message:

Field	Type	Description
header	Command Header	Command message header
channel ID	64s	Between 0 to 63

Reply Message:

Field	Type	Description
header	Reply Header	Command reply header

Return Value:

OK if successful.

Error Value	Description
Failed	The data channel could not be disabled.
Invalid State	The system is not currently stopped

Run System

This command starts up the system. Upon receiving the command, the FireSync server initiates a TCP connection to each enabled data channel.

Command Message:

Field	Type	Description
header	Command Header	Command message header
startTime	64u	The start time of the system. Set to 0 to start the system without delay

Reply Message:

Field	Type	Description
header	Reply Header	Command reply header

Return Value:

OK if successful.

Error Value	Description
Invalid state	Returned if the server is in booting or idle state, or a system is already running.
Failed	FireSync server cannot establish TCP connection, or if operation failed on more or more sensors.

Ping Command

This command allows the client to ping the server to detect if the connection to the server is still alive.

The timeout field sets the ping timeout timer for the system operation channel.

If the timeout period is set to non-zero, the client must send the next ping command to the server at an interval no longer than the specified timeout period. The server will disconnect the command channel if it does not receive the next ping command within the specified period.

If the timeout period is set to zero, the ping monitoring mechanism is disabled, and the client has no obligation to send the ping command. This is the default behavior on system startup.

Command Message:

Field	Type	Description
header	Command Header	Command message header
timeout	64s	Ping timeout period. (microseconds)

Reply Message:

Field	Type	Description
header	Reply Header	Command reply header

Return Value:

This command always returns OK.

Start Event Channel

This command starts the transmission of asynchronous events to a TCP server (specified by the *address* and *port* field). Similar to the System Start command, the FireSync server initiates the TCP connection. The event data channel is described in a later section.

The TCP server must be located at a subnet that could be connected by the Master, which is located in the 90.x.x.x subnet.

Command Message:

Field	Type	Description
header	Command Header	Command message header
reserved[4]	byte	Reserved
address[4]	byte	IP address of data receiving TCP connection
port	64s	Port of data receiving TCP connection

Reply Message:

Field	Type	Description
header	Reply Header	Command reply header

Return Value:

OK if successful.

Error Value	Description
Failed	If the TCP connection cannot be established

Stop Event Channel

This command stops event data streaming and disconnects the health data connection.

Command Message:

Field	Type	Description
header	Command Header	Command message header

Reply Message:

Field	Type	Description
header	Reply Header	Command reply message header

Return Value:

OK if successful.

Error Value	Description
Failed	The health channel could not be stopped

Get System Start Delay

This command returns the maximum time (in microseconds) that it takes the server to process a Start command and reply to the client. This value is useful when multiple servers must be started in a synchronized fashion. When starting such a system, it must be guaranteed that all servers have received and processed the start command before the start time value in the command.

Command Message:

Field	Type	Description
header	Command Header	Command message header

Reply Message:

Field	Type	Description
header	Reply Header	Command reply message header
startDelay	k64s	The maximum time this server takes to process a Start command, in microseconds.

Return Value:

OK if successful.

Error Value	Description
Failed	The health channel could not be stopped

Backup Storage

Issue this command to retrieve an image of the current server storage. If the operation is successful, the server responds with the image length and data.

Command Message:

Field	Type	Description
header	Command Header	Command message header

Reply Message:

Field	Type	Description
header	Reply Header	Reply message header
imageSize	64s	Size of the image
imageData[imageSize]	byte	Image data

Return Value:

OK if successful.

Error Value	Description
Failed	Backup image could not be created.

Restore Storage

This command can be used to restore the storage of the server with a backup image file. All existing files are overwritten on restore.

Command Message:

Field	Type	Description
header	Command Header	Command message header
imageSize	64s	Size of the backup image
fileData[imageSize]	byte	Backup image data

Reply Message:

Field	Type	Description
header	Reply Header	Reply message header

Return Value:

OK if successful.

Error Value	Description
Failed	Backup image could not be restored

Get Server Info

This command retrieves information about the server such as its serial number and model. This command will fail if the system is running.

Command Message:

Field	Type	Description
header	Command Header	Command message header

Reply Message:

Field	Type	Description
header	Reply Header	Reply message header
serialNumber	64s	Station serial number
modelName	char[32]	Station model name
storageFree	64s	Free storage space in bytes
appVersion	64s	Server application version. (Bits 63 – 32: Reserved Bits 31 – 24: Major Version Bits 23 – 16: Minor Version Bits 15 – 8: Build Version Bits 7 – 0: Patch Version)
reserved	byte[240]	Reserved for future and internal use

Return Value:

OK if successful.

Error Value	Description
Failed	Could not read the information

Get Sensor Info

This command retrieves information about the server such as its serial number and model. This command will fail if the system is running.

Command Message:

Field	Type	Description
header	Command Header	Command message header
serialNumber	64s	Serial number of the sensor

Reply Message:

Field	Type	Description
header	Reply Header	Reply message header
serialNumber	64s	Sensor serial number
modelName	char[32]	Sensor model name
appVersion	k64s	Sensor application version. (Bits 63 – 32: Reserved Bits 31 – 24: Major Version Bits 23 – 16: Minor Version Bits 15 – 8: Build Version Bits 7 – 0: Patch Version)
reserved	byte[248]	Reserved for future and internal use

Return Value:

OK if successful.

Error Value	Description
Failed	Could not read the information

Management Commands

The management commands are used for sensor system monitoring and server management.

Command	Identifier
Start Health Channel	0x2000
Stop Health Channel	0x2001
Set Public IP	0x2002
Ping	0x2003
Get Private IP	0x2004
Set Private IP	0x2005

Start Health Channel

This command starts the transmission of system health information to a TCP server (specified by the *address* and *port* field). Similar to the System Start command, the FireSync server initiates the TCP connection. The health data channel is described in a later section.

Command Message:

Field	Type	Description
header	Command Header	Command message header
reserved[4]	byte	Reserved
address[4]	byte	IP address of data receiving TCP connection
port	64s	Port of data receiving TCP connection

Reply Message:

Field	Type	Description
header	Reply Header	Command reply header

Return Value:

OK if successful.

Error Value	Description
Failed	If the TCP connection cannot be established

Stop Health Channel

This command stops health data streaming and disconnects the health data connection.

Command Message:

Field	Type	Description
header	Command Header	Command message header

Reply Message:

Field	Type	Description
header	Reply Header	Command reply message header

Return Value:

OK if successful.

Error Value	Description
Failed	The health channel could not be stopped

Set Public IP

This command changes the IP address of the public interface of the FireSync server. If the command returns success, the IP will be changed when the management connection is broken from the server. If the address field is 0, then automatic IP configuration by DHCP will be enabled.

Note: The subnet 90.0.0.0/255.0.0.0 is reserved for private use; therefore any address in this subnet is not valid for this command.

Command Message:

Field	Type	Description
header	Command Header	Command message header
reserved[4]	byte	Reserved
address[4]	byte	New network IP address
reserved[4]	byte	Reserved
mask[4]	byte	New subnet mask
reserved[4]	byte	Reserved
gateway[4]	byte	New gateway address

Reply Message:

Field	Type	Description
header	Reply Header	Command reply message header

Return Value:

OK if successful.

Error Value	Description
Failed	IP cannot be changed. This happens if the IP specified is invalid, or within the subnet of 90.xxx.xxx.xxx

Ping Command

This command allows the client to ping the server to detect if the connection to the server is still alive.

The timeout field sets the ping timeout timer for the management channel.

If the timeout period is set to non-zero, then the client must send the next ping command to the server at an interval no longer than the specified timeout period. The server will disconnect the management channel if it does not receive the next ping command within the specified period.

If the timeout period is set to zero, then the ping monitoring mechanism is disabled, and the client has no obligation to send the ping command. This is the default behavior on system startup.

Command Message:

Field	Type	Description
header	Command Header	Command message header
timeout	64s	Ping timeout period. (microseconds)

Reply Message:

Field	Type	Description
header	Reply Header	Command reply header

Return Value:

This command always returns OK.

Get Private IP

This command retrieves the private interface IP of the FireSync server.

Command Message:

Field	Type	Description
header	Command Header	Command message header

Reply Message:

Field	Type	Description
header	Reply Header	Command reply message header
reserved[4]	byte	Reserved
Address[4]	byte	New IP address

Return Value:

OK if successful.

Error Value	Description
Failed	The IP address of the private interface cannot be retrieved. This error can occur if the sensor interface is disconnected from any switch device (master or slave).

Set Private IP

The private interface IP can be changed through this command. In a system configuration where there are multiple servers on the same sensor data network, the servers must have different IPs on that network.

The valid addresses are 90.0.0.1 through 90.0.0.5. To ensure that there is no conflict, the Get Private IP can be used to retrieve the private addresses of the other servers.

Command Message:

Field	Type	Description
header	Command Header	Command message header
reserved[4]	byte	Reserved
address[4]	byte	New private network IP address

Reply Message:

Field	Type	Description
header	Reply Header	Command reply message header

Return Value:

OK if successful.

Error Value	Description
Failed	IP cannot be changed. This happens if the IP specified is invalid.

Upgrade Commands

The upgrade commands are used for system upgrades. Typical usage is to transmit an upgrade package file through the Start Upgrade command, and then monitor the progress with the Get Status command until the process is finished. The Get Log command can be used to retrieve an error log if problem occurs.

Command	Identifier
Start Upgrade	0x0000
Get Status	0x0001
Get Log	0x0002

Start Upgrade

This command begins the upgrade process by transmitting an upgrade package file to the server.

Command Message:

Field	Type	Description
header	Command Header	Command message header
packageSize	k64s	Size of the upgrade package file
package[packageSize]	byte	Image of the upgrade package file

Reply Message:

Field	Type	Description
header	Reply Header	Command reply message header

Return Value:

OK if successful.

Error Value	Description
Failed	The upgrade cannot be started due to unspecified error. The Get Log command can be used to retrieve detailed description of the failure.
Invalid State	The system is currently in a state that does not allow upgrade (running or paused).

Get Status

This command queries the current status of the upgrade progress.

Command Message:

Field	Type	Description
header	Command Header	Command message header

Reply Message:

Field	Type	Description
header	Reply Header	Command reply message header
step	64s	The current upgrade process step (see below)
stepProgress	64s	Progress of the currently running step as a percentage value

Here is a table of the possible upgrade step values

Step	Value	Description
Upgrade Completed	0	The previous upgrade completed successfully
Upgrade Failed	-1	The previous upgrade failed
Upgrading Server	1	Upgrading server files
Upgrading Sensors	2	Upgrading sensor firmware
Resetting Sensors	3	Resetting all sensors after firmware load

Remarks: Once the upgrade process stops due to completion or error, the current step is either Upgrade Completed or Upgrade Failed.

Return Value:

OK if successful.

Error Value	Description
Failed	Could not retrieve upgrade progress

Get Log

In case of upgrade programs, the Get Log command can be used to retrieve the upgrade log and aid in troubleshooting.

Command Message:

Field	Type	Description
header	Command Header	Command message header

Reply Message:

Field	Type	Description
header	Reply Header	Command reply message header
logSize	k64s	Size of the upgrade log
Log[logSize]	char	The upgrade log in string format

Return Value:

OK if successful.

Error Value	Description
Failed	Could not retrieve the upgrade log

UDP Broadcast Protocol

The UDP broadcast protocol can be used to retrieve and set the network configuration of a station with unknown settings. To send command to a station, a UDP packet must be send to the following broadcast destination:

Destination Address	Destination Port
255.255.255.255	3220

Each command identifies its target with a serial number. After the command is processed, the station generates another broadcast UDP packet that is sent to the port of the command sender.

Destination Address	Destination Port
255.255.255.255	Port of command sender

Get IP Settings

Send this command to retrieve the current network settings of a station. If a network interface is not connected at the time, then “0.0.0.0” is returned for that interface.

Command Message:

Field	Type	Description
length	64s	Total message size (0x20)
id	64s	0x0001
signature	64s	0x0000504455494D4C
serialNumber	64s	Serial number of destination station

Reply Message:

Field	Type	Description
length	64s	Total message size (0x48)
id	64s	0x1001
status	64s	Return code
signature	64s	0x0000504455494D4C
serialNumber	64s	Serial number of source station
publicIsDhcp	64s	1 if public interface uses DHCP. 0 otherwise
reserved[4]	byte	Reserved
publicAddress[4]	byte	Public interface address
reserved[4]	byte	Reserved
publicMask[4]	byte	Public interface mask
reserved[4]	byte	Reserved
publicGateway[4]	byte	Public interface gateway
reserved[4]	byte	Reserved
privateAddress[4]	byte	Private interface address

Return Value:

OK if successful.

Error Value	Description
Failed	Could not get address

Set IP Command

This command is used to set the network settings of the station. If the public interface does not use DHCP and the address is specified to be "0.0.0.0", then the public address is not set. Likewise, specifying "0.0.0.0" for the private address causes it to be ignored also.

Command Message:

Field	Type	Description
length	64s	Total message size (0x40)
id	64s	0x0002
signature	64s	0x0000504455494D4C
serialNumber	64s	Serial number of destination station
publicIsDhcp	64s	1 if public interface uses DHCP. 0 otherwise. If DHCP is used, then the static address information is ignored.
reserved[4]	byte	Reserved
publicAddress[4]	byte	Public interface address
reserved[4]	byte	Reserved
publicMask[4]	byte	Public interface mask
reserved[4]	byte	Reserved
publicGateway[4]	byte	Public interface gateway
reserved[4]	byte	Reserved
privateAddress[4]	byte	Private interface address

Reply Message:

Field	Type	Description
length	64s	Total message size (0x28)
id	64s	0x1002
status	64s	Return code
signature	64s	0x0000504455494D4C
serialNumber	64s	Serial number of source station

Return Value:

OK if successful.

Error Value	Description
Failed	Could not set the address(es)

Data Channels and Format

While the command channels are used to operate the system, information from a server is sent back to the client over data channels. There are three such channels: the sensor data channel, the health data channel and the event channel.

A common generic data format is used over all of these channels. This format is referred to as the FireSync Result format and is described in details in this chapter.

FireSync Result Format

The FireSync Result format has the following general structure.

Field		Type	Description
size		64s	Total size of message
id		64s	Message identifier
attributeCount		64s	Number of attributes
itemCount		64s	Number of items
attributes		64s	first attribute
		...	
		64s	n th attribute (n specified by attributeCount)
itemDescriptors	length0	64s	First-dimension length of first item
	length1	64s	Second-dimension length of first item
	length2	64s	Third-dimension length of first item
	type	64s	Item type of first item
	...		
	length0	64s	First-dimension length of n th item
	length1	64s	Second-dimension length of n th item
	length2	64s	Third-dimension length of n th item
	type	64s	Item type of n th item
	...		
itemData	data0	block	Content of first item
	...		
	data _n	block	Content of of n th item

Each item descriptor describes the block of data at the corresponding index in the data section. The data block is the flatten result of an array which can be in any of one, two, or three dimensions. The length fields in the descriptor contain the lengths in the three dimensions. Only length0 is valid for a one dimensional array, and length0 and length1 for a two dimensional array. The lengths are followed by the item type, which is an identifier for a primitive type, and is defined by the following table.

Type Identifier	Type Description
1	8-bit unsigned integer
2	8-bit signed integer
3	16-bit unsigned integer
4	16-bit signed integer
5	32-bit unsigned integer
6	32-bit signed integer
7	64-bit unsigned integer
8	64-bit signed integer
9	byte
10	single byte character
11	64-bit floating point number

To access the data of a two dimensional array, the item at subscripts [i][j] is located at item offset $i * \text{length1} + j$; for a three dimensional array, the item at [i][j][k] is located at item offset $i * \text{length1} * \text{length2} + j * \text{length2} + k$.

FireSync Sensor Data Channel

When a Start System command is issued by the client to the server, a connection is made by the server to the TCP end-point specified in the command. This connection is referred to as the sensor data channel. Once the system is started and the connection made, data is automatically streamed to the client at a pace defined by the particular sensor system application.

The general format of the data is compatible with the FireSync Result format; however the exact format depends on the sensor system application.

FireSync Health Data Channel

When the Start Health Channel command is issued to the server and the health channel is established successfully by the server to the client machine on the specified port, health information is pushed automatically through on a pre-configured interval. Issuing a Stop Health Channel command stops this streaming and terminates the connection.

Health Data Format

The health data channel uses the FireSync Result format which is described in the previous section. Each node in the system, sensor and server alike, sends out one FireSync Result message at a pre-configured interval.

The ID field of the result message indicates the type of the source node:

Value	Type
1000	Health Message

The attributes contain the serial number of the originating node:

Attribute Index	Description
0	Serial number of originating node

The data is a 2-dimensional array of 64s, where each row is referred to as a health “indicator”. The number of indicators per sensor or server depends on the application, but is constant throughout system operation.

Each health indicator has the following format:

Type	Description
64s	Unique Identifier
64s	Instance Id
64s	Value

The content of a FireSync result block for probes are:

Field	Value
-------	-------

Field		Value
size		Variable depending on number of probes
id		1000
attributeCount		1
itemCount		1
attributes		Serial Number
itemDescriptors	length0	Number of indicators
	length1	3 (Unique identifier + Instance Id + value)
	length2	0 (Not used)
	type	8 (64-bit signed integer)
Indicators	Indicator0	First Indicator
	...	Up to number of indicator specified by length0

For a list of available indicators and their corresponding value field meanings, please refer to the health indicator section.

FireSync Event Data Channel

The operation is identical to that of the health data channel, except Start/Stop Event Channel are used to control the channel, and the ID field of 1001 is used.

Chapter 4

Health Indicators

This section describes the indicators that are provided by the FireSync platform.

Sensor Indicators

The following table describes the indicators that are transmitted for each sensor. Unless otherwise specified, all logging intervals begin at sensor power-up.

Name	ID	Instance ID	Description
App Version	1000	N/A	Sensor application firmware version. (Bits 63 – 32: Reserved Bits 31 – 24: Major Version Bits 23 – 16: Minor Version Bits 15 – 8: Build Version Bits 7 – 0: Patch Version)
Temperature	1001	N/A	Current temperature. (degrees C)
Memory Level	1002	N/A	Current memory usage. (percentage)
Voltage Status	1003	N/A	Current status of sensor voltages. (0: Normal; 1: Error)
Voltage Errors	1004	N/A	Count of detected voltage errors.
Camera Status	1200	Camera ID	Current camera status. (0:Normal; 1:Error)
Camera Errors	1201	Camera ID	Count of detected camera errors.
Camera Losses	1202	Camera ID	Count of lost camera frames.
Sync Status	1203	N/A	Current status of synchronization communication between the sensor and the FireSync Master. (0:Normal; 1:Error)
Sync Errors	1204	N/A	Count of detected synchronization communication errors.
Data Status	1300	N/A	Current status of data communication between the sensor and the FireSync Server. (0:Normal; 1:Error)
Data Errors	1301	N/A	Count of detected data communication errors.
Data Losses	1302	N/A	Count of detected data communication losses.

Server Indicators

The following table describes the indicators that are transmitted for each server. Unless otherwise specified, all logging intervals begin at server power-up.

Name	ID	Instance ID	Description
App Version	2000	N/A	Server application version. (Bits 63 – 32: Reserved Bits 31 – 24: Major Version Bits 23 – 16: Minor Version Bits 15 – 8: Build Version Bits 7 – 0: Patch Version)
Temperature	2001	1: Master	Current temperature of the components. (degrees C)
Encoder Frequency	2002	N/A	Current input encoder frequency detected by the system.
Encoder Value	2003	N/A	Current input encoder value.
Encoder Index	2004	N/A	Current input encoder index value.
Digital I/O States	2005	N/A	Current states digital I/Os (0 – inactive, 1 – active) Bit 0: Input 0 State Bit 1: Input 1 State Bit 2: Input 2 State Bit 3: Input 3 State
System Restarts	2200	N/A	Count of system restarts due to error.
System State	2201	N/A	Current system state. (see FireSync Host Protocol Reference)
Server Uptime	2202	N/A	Uptime of the server (μ s)
Communication Interface Status	2300	0: Sensor 1: Client	Status of server communication interfaces. (0:Normal; 1:Error)
Data Losses	2301	N/A	Count of data frames dropped by server.
Sensor Communication Status	2302	Sensor S/N	Status of control communication between server and sensor. (0:Normal; 1:Missing; 2:Error)
Sensor Data Losses	2303	Sensor S/N	Count of data frames dropped by sensor.
Sensor Restarts	2304	Sensor S/N	Count of sensor restarts due to error.
Sensor State	2305	Sensor S/N	State of the sensor. (1: Error 2: Ready 3: Running 4: Paused 5: Boot Failure)
Client Data Rate	2306	N/A	Data rate (in kB/s) of output to client
Startup Latency	2307	N/A	Latency of the previous start command; measured between command arrival and reply transmission

			(μ s)
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Event Indicators

The following table describes the indicators that are transmitted on the event data channel. Unless otherwise specified, all logging intervals begin at master power-up.

Some of the information overlaps with those from the server. The event data channel is intended for transmitting indicators at higher frequency (100Hz).

Name	ID	Instance ID	Description
App Version	3000	N/A	Master application version. (Bits 63 – 32: Reserved Bits 31 – 24: Major Version Bits 23 – 16: Minor Version Bits 15 – 8: Build Version Bits 7 – 0: Patch Version)
Encoder Value	3003	N/A	Current input encoder value.
Encoder Index	3004	N/A	Current input encoder index value.
Digital I/O States	3005	N/A	Current states digital I/Os (0 – inactive, 1 – active) Bit 0: Input 0 State Bit 1: Input 1 State Bit 2: Input 2 State Bit 3: Input 3 State