visual engineering
LIGHTWARE

SUMMARY OF LIGHTWARE'S OPEN API ENVIRONMENT

Introduction

What is an API?

An Application Programming Interface (API) is a set of protocols, commands, functions and objects that programmers can use to create software or interact with an external system.

The API developed by Lightware Visual Engineering for its video signal management equipment is an open environment protocol, where every bit of data is openly available for higher level management, control and monitoring systems. The protocol descriptions are openly available and the set of protocols typically used in a given device is always included in the product's User's Manual.

LW2 and LW3 Protocol Sets

There are two sets of protocols of Lightware API system: LW2 is a simpler, but very definite set of protocols, while LW3 is more sophisticated, allowing fine-tuning of processes in more detail. These protocols are present in the Lightware devices, no additional purchase or subscription are necessary to use them. To check the current LW2 or LW3 communication in the devices, the freely downloadable Lightware Device Controller software can be used to connect to the Lightware device over one of the available connections. The current communication and settings will appear in the terminal window.

Lightware API Development

The LW2 protocol set is released in 2006 with the first generation matrix switchers and distribution amplifiers. In most of Lightware's more recent products a reduced set of LW2 reference is included to maintain backwards compatibility.

LW3 is a newer and much more capable protocol first released in 2012, it is transparent, browsable, queryable and can be parametrized, and was created to serve new technologies demanding a wider scale of parametrization. LW3 has a tree structure and based on a very similar principle, basically most function works the same way, as the commands, paths and parameters are the same.

The commands can be sent over various types of connections including Ethernet, serial RS-232 and USB – depending on the capabilities of the given device.

Safe and Simple

The applicable parameters are adjustable on a wide scale, nevertheless for safety and security limits are also set, in order to avoid causing permanent harm to a device. Both sets of protocol are uncomplicated and designed to be very user friendly, it is only at the most rare occasions when in extreme cases longer command lines need to be used. Both LW2 and LW3 can query and modify the most important properties and settings of a device by sending commands:

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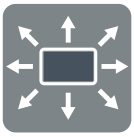
10 Advantages of the Lightware Protocols



Complex controlling and monitoring the features of Lightware devices
From the Input port switching to the hexadecimal-formatted message sending.

Live protocol browsing by the freely available Lightware Device Controller (LDC) software
From the live terminal to the tree structure.

All-in-one commands
Changing the same property at all ports by sending only one command (e.g. changing the I/O crosspoint).

Transparent Ethernet
Direct connection to remote Ethernet devices (e.g. source or sink devices).

Serial-Ethernet bi-directional signal conversion
Use the Command Injection mode to extend RS-232 serial data.

Subscription
Getting a change message automatically if a parameter is changed in the background.

Monitoring and identifying potential twisted pair cable issues
By the TPS Cable Diagnostic Tools.

Monitoring the status of the connected devices, cables, and signals of each I/O port
Signal present, +5V present, hotplug detection.

Querying and changing the video parameters of the signals
Timing, frequencies, scan mode, HDCP encryption, color space, audio sample rate, and many more.

Configurable analog audio parameters
Volume, Gain, Balance, Treble, Bass settings.

Advanced Feature
This icon means the mentioned feature is the part of a feature package and available only for certain models.

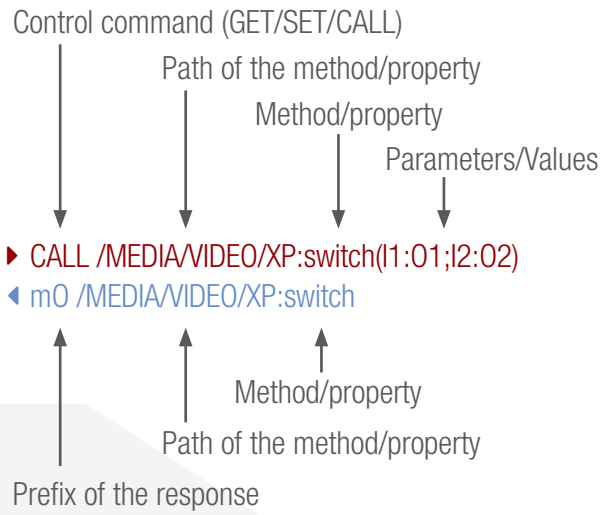
Lightware Protocol #3 (LW3)

The Lightware Protocol #3 (LW3) is implemented in almost all new Lightware devices (matrix switchers, signal extenders and distribution amplifiers) since 2012. The protocol is ASCII-based and all commands are terminated with a carriage return (Cr, '\r') and line feed (Lf, '\n') pair. It is organized as a tree structure that provides outstanding flexibility and user-friendly handling with 'nodes', 'properties' and 'methods'. The Advanced View of the Lightware Device Controller software is the perfect tool for browsing and learning how the LW3 protocol can be used in practice.

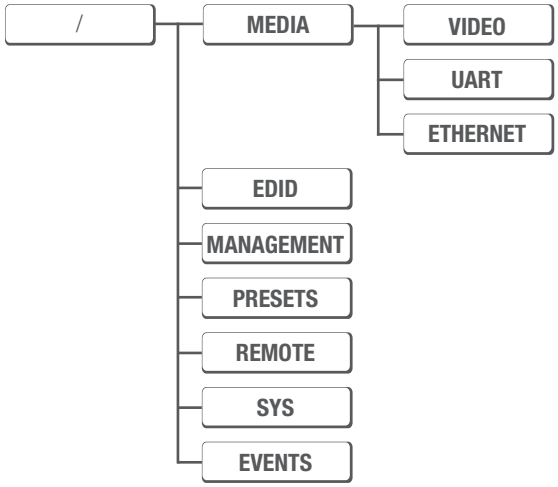
Protocol Rules

- All names and values are case-sensitive.
- The nodes are separated by a slash ('/') character.
- The node name can contain the elements of the English alphabet and numbers.
- The length of a line (command/response, command type / prefix, path, method/property and parameters together) can be max. 800 byte.
- The command lines have to be closed by Carriage return and Line Feed (CrLf)
- Use the TCP port no. 6107 when using LW3 protocol over Ethernet.
- When a command is issued by the device, the received response cannot be processed by the CPU.
- The path of a node has to contain all parent nodes from the root node.

The LW3 Command Structure



The LW3 Tree Structure (HDMI20-OPTC-TX series)



Control Commands

- **GET:** It can be used to get the child nodes, properties, and methods of a node or the value of a property.
- **SET:** The setter command can be used to modify the value of a property.
- **CALL:** A method can be executed by the 'CALL' command.

The Prefix of the Response

The prefixes are defined to supply information about the response and the executed command like:

- **m0:** A successful method execution ('method OK').
- **mE:** Unsuccessful method execution (an error code is followed).
- **pR:** Read-only property (e.g. when querying a parameter).

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Subscription

Subscribing to a node means that the user will get a notification if any of the properties of the node is changed. These notifications are asynchronous messages and hence, they are useful to keep the client application up to date without receiving any unwanted information. Example:

- OPEN /MEDIA/VIDEO/*
- o- /MEDIA/VIDEO/*

If a property is changed under the /MEDIA/VIDEO node (including all child nodes) a 'change message' will be sent:

- CHG /MEDIA/VIDEO/QUALITY.QualityMode=video

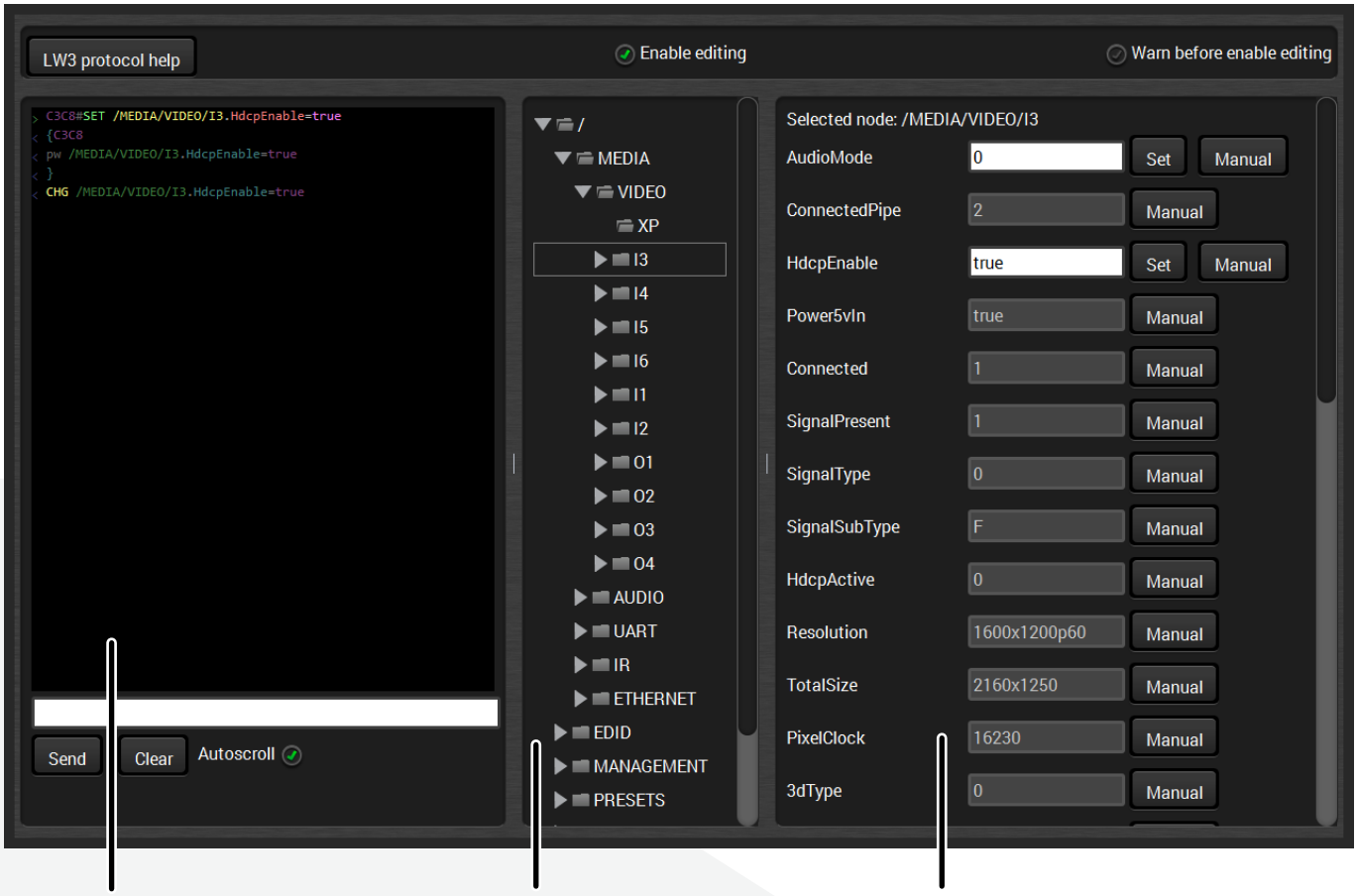
(Sending the 'OPEN' command without the * character the child nodes will not be checked, only the /MEDIA/VIDEO node.)

The Manual

For every node, property and method in the tree there is a manual. The manual is a human readable text that describes the syntax and provides a hint how to use the primitives:

- MAN /MEDIA/VIDEO/O1.Pwr5vMode
- pm /MEDIA/VIDEO/O1.Pwr5vMode ["0" | "1" | "2"] 0 - Auto, 1 - Always On, 2 - Always Off

The Appearance in Lightware Device Controller (Advanced View)



Terminal Window
Listing all the excuted commands and responses.

LW3 Protocol Tree
Showing the whole structure of the nodes and child nodes in the LW3 tree.

Properties and Methods
Listing the available properties and methods with the current values.

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A/V Port-related LW3 Commands (Extraction)

Querying the Crosspoint Status (View Connections)

- GET /MEDIA/VIDEO/XP.DestinationConnectionList
- pr /MEDIA/VIDEO/XP.DestinationConnectionList=I1;I3;I1;I3

Example: The response shows four outputs are in device: Input 1 is connected to Output 1 and Output 3, while Input 3 is connected to Output 2 and Output 4.

Switching an Input to an Output

- CALL /MEDIA/VIDEO/XP:switch(I4:O1)
- m0 /MEDIA/VIDEO/XP:switch

Explanation: Input 4 is switched to Output 1. The whole crosspoint can be changed by sending this commands as more switching parameters can be inserted in the round brackets.

Querying the Input Video Signal Presence

- GET /MEDIA/VIDEO/I1.SignalPresent
- pr /MEDIA/VIDEO/I1.SignalPresent=1

Explanation: '1' means signal is present at Input 1. When the response value is '0', no signal is present.

Querying the HDCP State

- GET /MEDIA/VIDEO/I1.HdcpState
- pr /MEDIA/VIDEO/I1.HdcpState=1

Explanation: The value of the property is '1' which means HDCP encryption is enabled at Input 1. (HDCP is disabled when the value is '0'.) Use the SET command to change the value of the property.

Muting one or more Input ports

- CALL /MEDIA/VIDEO/XP:muteSource(I1;I4)
- m0 /MEDIA/VIDEO/XP:muteSource

Explanation: Sending the above command the Input 1 and Input 4 ports will be muted.

Querying the Status of the Input Ports

- GET /MEDIA/VIDEO/XP.SourcePortStatus
- pr /MEDIA/VIDEO/XP.SourcePortStatus=T000F;M000A;T00EF;L00AA;U000A;T000A

Explanation: The status of the input ports can be queried by one single command. Above response contains six groups (Input 1-6) separated by semicolons carrying the following information:

- **Letter:** T=unmuted and unlocked; M=muted; L=locked; U=locked and muted
- **HEX code** (2 bytes): showing different statuses of audio embedding, HDCP, connection, and signal presence.

The above response contains the 'T00EF' value which refers to the Input 3 (this is the third group):

- **T:** the port is unmuted and unlocked
- **00:** reserved characters
- **E:** embedded audio is present
- **F:** source is connected, signal is present

Querying the Video Input Autoselection Settings

The feature means that the output port can be set to select an input port automatically. The settings allow different approach how an input is selected to the output. See more information in the User's Manuals of the devices.

- GET /MEDIA/VIDEO/XP.DestinationPortAutoselect
- pr /MEDIA/VIDEO/XP.DestinationPortAutoselect=EL

Explanation: 'E' means the Autoselect feature is enabled, 'L' means 'Last detect mode' is the active mode. The setting means: always the last connected signal will be selected to the given output automatically.

Changing the Video Input Autoselection Settings

- CALL /MEDIA/VIDEO/XP:setDestinationPortAutoselect(O1:EP)
- m0 /MEDIA/VIDEO/XP:setDestinationPortAutoselect

Explanation: The Autoselect mode has been set at Output 1 as follows:

- **E:** Autoselect is enabled.
- **P:** Priority mode is active (always the highest priority active input is selected to the output).

Setting the Volume Level of the Analog Audio Output Port

- SET /MEDIA/AUDIO/O2.VolumedB=-15
- pw /MEDIA/AUDIO/O2.VolumedB=-15.00

Explanation: The above command can be used to set the volume level to a specific value. You can also change the volume between 0% and 100% by using the 'VolumePercent' property.

Device State Commands

Querying the Health Status (CPU Temperature)

- GET /MANAGEMENT/STATUS.CpuTemperature
- pr /MANAGEMENT/STATUS.CpuTemperature=42 C; 0;75; 0;79;22;54;

Explanation: According to the first value the current temperature of the CPU is 42°C.

Querying the Health Status (5V)

- GET /MANAGEMENT/STATUS.5VMain
- pr /MANAGEMENT/STATUS.5VMain=5.06 V;4.50;5.50;4.28;5.77;4.12;5.09;

Explanation: According to the first value the current Voltage of the '5V' is 5.06V.

Cable Diagnostics

- GET /REMOTE/S1.HdbtStat
- pr /REMOTE/S1.HdbtStat=-22; -22; -23; -21

Explanation: The response contains the measured error rates of the four transmission channels (twisted par) in the CATx cable. The values are in dB; the lowest the best. ('S1' node means Source 1 = Input 1).

- GET /REMOTE/S1.TxBer
- pr /REMOTE/S1.TxBer=1e-10

Explanation: The value of the property is the Bit Error Ratio (BER) of the transmitter side. The 1e-10 (10^{-10}) value means there is 1 bad pixel on average after transmitting 10^{10} pixels; e.g. there is 1 bad pixel in every 80 seconds when the transmitted signal is 1920x1080p @ 60 Hz.

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Querying the Product Name

- GET /.ProductName
- pr /.ProductName=VINX-120-HDMI-ENC

Explanation: The response contains the product name (read-only parameter).

Resetting the Device

- CALL /SYS:reset()
- m0 /SYS:reset

Explanation: The device is restarted, the current connections (Ethernet, RS-232, USB) are terminated.

Querying the DHCP State (Dynamic IP Address Setting)

- GET /MANAGEMENT/NETWORK.DhcpEnabled
- pw /MANAGEMENT/NETWORK.DhcpEnabled=true

Explanation: The property is 'true' that means the IP address of the device is set by the DHCP server of the LAN.

Setting a Static IP Address

- SET /MANAGEMENT/NETWORK.StaticIpAddress=192.168.0.85
- pw /MANAGEMENT/NETWORK.StaticIpAddress=192.168.0.85

Explanation: A static IP address is set; it will be valid only if the 'DhcpEnabled' property is set to 'false'.

Setting the BAUD Rate of the RS-232 Port

- SET /MEDIA/UART/P1.Baudrate=2
- pw /MEDIA/UART/P1.Baudrate=2

Explanation: The BAUD rate setting is '2' which means 9600 BAUD; the '0' and '7' values mean different BAUD rates.

Toggle the Level of a GPIO Pin

Certain devices contain a GPIO (General Purpose Input/Output) port with adjustable pins. If the GPIO pin direction is set to Output, the Output level can be toggled between high and low:

- CALL /MEDIA/GPIO/P1:toggle(1)
- m0 /MEDIA/GPIO/P1:toggle

Explanation: the output level has been toggled. The feature can be used as a trigger e.g. for a connected relay.

Device Filter Based on MAC Address

You can create a list of network devices based on the MAC address which are allowed controlling the device, or querying parameters to/from the Lightware device.

Adding a new device:

- SET /MANAGEMENT/MACFILTER/MACaddress4=(04:D4:C4:4D:01:43;1;1;Tech)
- pw /MANAGEMENT/MACFILTER/MACaddress4=(04:D4:C4:4D:01:43;1;1;Tech)
- SET /MANAGEMENT/MACFILTER.FilterEnable=true
- pw /MANAGEMENT/MACFILTER.FilterEnable=true

Explanation: New MAC address is saved into the 4th property with name 'Tech', which may query/set parameters from/in the Lightware device. The FilterEnable property is set to true, thus, the filter is enabled.

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Event Manager-Related Commands

Macros

Macro is a batch of pre-defined commands stored in the device. Type the LW3 commands into a file and upload it to the device by Lightware Device Controller software. After that, the macros can be run by an LW3 command. The number of the macros depends on the device type, most devices can handle up to 50 macros.

Running a macro:

- CALL /CTRL/MACROS:run(Macro1)
- m0 /CTRL/MACROS:run

Explanation: The macro named 'Macro1' is made to run.

Variables

Text- or string-type variables (determined automatically) can be defined in the device (30 pcs.) which are available also in the Event Manager. The variables can be used to store some kind of status information of an external device (e.g. button/light state, signal type, time/temperature value, etc...) and it can be also processed by iternal tools (addition, subtraction, parameter scanning). The value can be set directly or get by an LW3 property e.g. TCP message recognizer.

- SET /CTRL/VARS/V1.Value=120
- pw /CTRL/VARS/V1.Value=120

Triggering a Condition

This feature works like a condition is fulfilled. When a complex control system is built, a condition may trigger numerous actions. A typical example is when a system is powered on and the 'ready-to-use' state has to be loaded. In this case, there could be many actions which are based on the same condition. In order to reduce the number of the commands, you can trigger one 'key' condition, which starts the whole process.

- CALL /EVENTS/E1:triggerCondition(1)
- mo /EVENTS/E1:triggerCondition

The condition of event1 is fulfilled, the set action will be launched (after the time delay if set).

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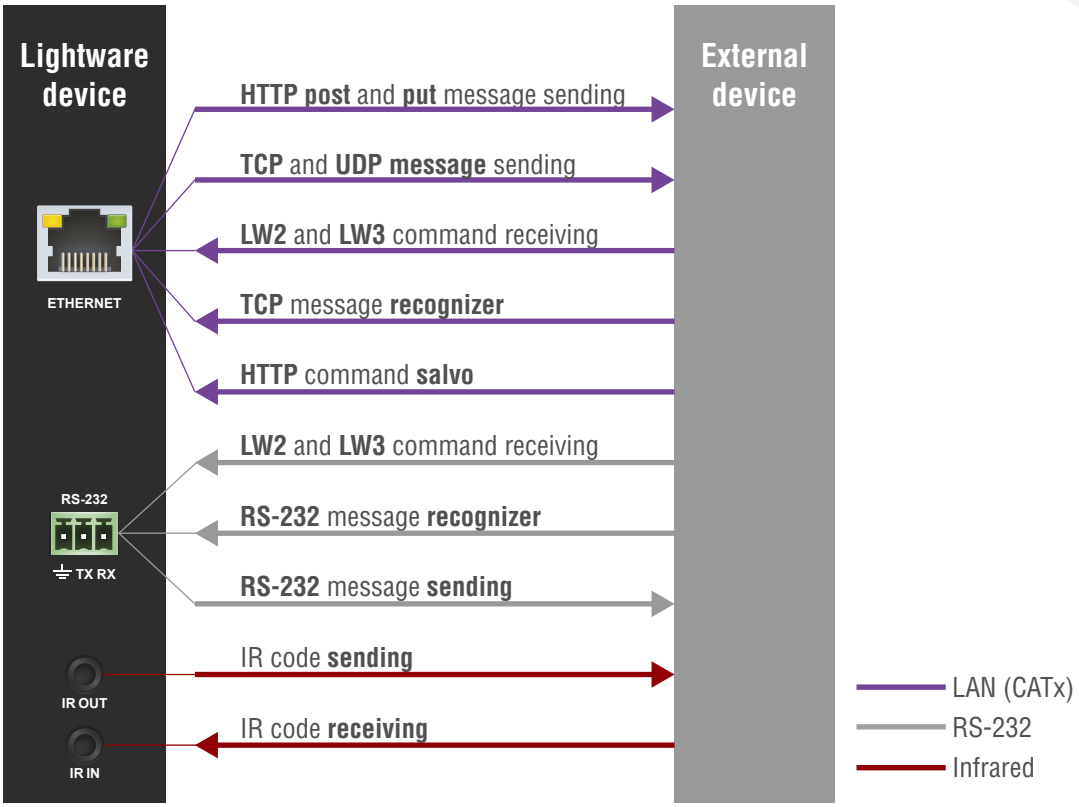
Message Sending and Receiving

Lightware devices offer many ways to communicate with other devices. Below figure shows a general overview about the possibilities (please note that the availability of the features is device-dependent):



Sending a TCP Message

The commands below can be used to send TCP messages. This first method allows escaping the control characters:

- CALL /MEDIA/ETHERNET:tcpMessage(192.168.0.20:5555=C00\x0a\x0d)
- mO /MEDIA/ETHERNET:tcpMessage

Explanation: The 'C00' message with CrLf (Carriage return and Line feed) is sent to the indicated IP:port address. The \x sequence indicates the following HEXA code (control characters).

The following method does not allow escaping or inserting control characters:

- CALL /MEDIA/ETHERNET:tcpText(192.168.0.20:5555=open)
- mO /MEDIA/ETHERNET:tcpText

Explanation: The 'open' text is sent to the indicated IP:port address.

The last command is for sending a binary message in Hexadecimal format. This method does not require escaping or inserting control characters:

- CALL /MEDIA/ETHERNET:tcpBinary(192.168.0.20:5555=433030)
- mO /MEDIA/ETHERNET:tcpBinary

Explanation: The '433030' message is sent to the indicated IP:port address.

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Sending a UDP Message

The commands below can be used to send UDP messages. This first method is for sending a UDP message in ASCII-format and it allows escaping the control characters.

- CALL /MEDIA/ETHERNET:udpMessage(192.168.0.103:4999=C00)
- m0 /MEDIA/ETHERNET:udpMessage

Explanation: The 'C00' message is sent to the indicated IP:port address.

The following method does not allow escaping or inserting control characters:

- CALL /MEDIA/ETHERNET:udpText(192.168.0.20:9988=open)
- m0 /MEDIA/ETHERNET:udpText

Explanation: The 'open' text is sent to the indicated IP:port address.

The last command is for sending a binary message in Hexadecimal format. This method does not require escaping the control and non-printable characters:

- CALL /MEDIA/ETHERNET:udpBinary(192.168.0.20:9988=433030)
- m0 /MEDIA/ETHERNET:udpBinary

Explanation: The '433030' message is sent to the indicated IP:port address.

TCP Message Recognizer

This tool is able to recognize and store the incoming TCP message until the previously defined string (delimiter) is arrived or the timeout elapsed after the last data. The combination of the TCP recognizer and the Event Manager gives numerous opportunities for creating automatic room solutions.

Preparation – the following commands are necessary to send as first step:

- SET /CTRL/TCP/C<loc>.ServerIP=<IP_address>
- SET /CTRL/TCP/C<loc>.ServerPort=<port_no>
- SET /CTRL/TCP/C<loc>.DelimiterHex=<delimiter>
- SET /CTRL/TCP/C<loc>.TimeOut=<timeout>

Querying the Last Recognized Message (String):

- GET /CTRL/TCP/C1.Rx
- pr /CTRL/TCP/C1.Rx=PWR_off

Querying the Last Recognized Message (Hex):

- GET /CTRL/TCP/C1.RxHex
- pr /CTRL/TCP/C1.RxHex=5057525F6F6666

The recognized data is also stored in the 'Active' properties temporary. When the time set in the ActiveTimeout property is elapsed, the property is cleared. Querying the Last Recognized Active Message (String):

- GET /CTRL/TCP/C1.ActiveRx
- pr /CTRL/TCP/C1.ActiveRx=AudOut+

Querying the Last Recognized Active Message (Hex):

- GET /CTRL/TCP/C1.ActiveRxHex
- pr /CTRL/TCP/C1.ActiveRxHex=4175644F75742B00

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HTTP Messaging

This feature means posting or putting HTTP messages from the Lightware device to another device for more integration but encrypted transmission (HTTPS) is not supported.

Preparation – the following commands are necessary to send as first step:

- SET /CTRL/HTTP/C1.ServerIP=<IP_address>
- SET /CTRL/HTTP/C1.ServerPort=<port_no>
- SET /CTRL/HTTP/C1.File=<path>

Setting the Message Header:

- SET /CTRL/HTTP/C1.Header=Host: 192.168.0.220\r\nContent-Type: text/xml\r\nAuthorization: Basic YWRtaW46=
- pw /CTRL/HTTP/C1.Header=Host: 192.168.0.220\r\nContent-Type: text/xml\r\nAuthorization: Basic YWRtaW46=

Sending a Post Message:

- CALL /CTRL/HTTP/C1:post(<Command><Message><Send><Text>LI1R_P</Text></Send></Message></Command>)
- m0 /CTRL/HTTP/C1:post

Sending a Put Message

- CALL /CTRL/HTTP/C1:put(<Command><Message><Send><Text>LI1R_P</Text></Send></Message></Command>)
- m0 /CTRL/HTTP/C1:put

Message Sending over the RS-232 Port

If the serial port settings match at both parties and the connection is established, the commands below can be used. This first method is for sending a message in ASCII-format; it allows escaping the control characters:

- CALL /MEDIA/UART/P1:sendMessage(C00/r/n)
- m0 /MEDIA/UART/P1:sendMessage

Explanation: A message is sent out via the P1 (local) serial port; the message is 'C00' and closed by /r/n. It can be also sent via another serial port (e.g. over the TPS connection), thus, devices can be controlled remotely.

The following method does not allow escaping the control and non-printable characters.

- CALL /MEDIA/UART/P1:sendText(open)
- m0 /MEDIA/UART/P1:sendText

The last command is for sending a binary message in Hexadecimal format. This method does not require escaping the control and non-printable characters.

- CALL /MEDIA/UART/P1:sendBinaryMessage(433030)
- m0 /MEDIA/UART/P1:sendBinaryMessage

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RS-232 Message Recognizer

This tool is able to recognize and store the incoming RS-232 message until the previously defined string (delimiter) is arrived or the timeout elapsed after the last data.

Preparation – the following commands are necessary to send as first step:

- SET /MEDIA/UART/RECOGNIZER.DelimiterHex=3a
- SET /MEDIA/UART/RECOGNIZER.TimeOut=20

Querying the Last Recognized Message (String):

- GET /MEDIA/UART/RECOGNIZER.Rx
- pr /MEDIA/UART/RECOGNIZER.Rx=Login:

Querying the Last Recognized Message(Hex):

- GET /MEDIA/UART/RECOGNIZER.RxHex
- pr /MEDIA/UART/RECOGNIZER.RxHex=FF1F4C6F67696E3A

The recognized data is stored in the 'Active' properties temporary. When the set time (ActiveTimeout property) is elapsed, the 'Active' properties are emptied. Querying the Last Recognized Active Message (String):

- GET /MEDIA/UART/RECOGNIZER.ActiveRx
- pr /MEDIA/UART/RECOGNIZER.ActiveRx=Login:

Querying the Last Recognized Active Message (Hex):

- GET /MEDIA/UART/RECOGNIZER.ActiveRxHex
- pr /MEDIA/UART/RECOGNIZER.ActiveRxHex= 4C6F67696E3A

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Summary about Special Features

Product	Advanced Control Pack v1			Smart Features gen 2.			Advanced Control Pack v3												
	IR code sending	CEC	RS-232 recognizer	Miniweb	Forced button lock	Dark mode	Wake-on-lan	'Connected source' property	Event Manager AND operator	Event Manager variables	Event Manager condition trigger	Cleartext login	IP port block	MAC filtering	TCP recognizer	LW3 command salvo	Running Macros	HTTP post and put	LMDMP (highlightMe feature)
MMX4x2-HDMI	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MMX4x2-HT200	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MMX4x2-HDMI-USB20-L	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MMX8x8-HDMI-4K-A, -USB20	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MMX8x4-HT420, -HT400	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
RAP-B511	-	-	✓	✓	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
HDMI-TPS-TX210, -TX220	-	-	-	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-
DVI-HDCP-TPS-TX210, -TX220	-	-	-	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-
DP-TPS-TX210, -TX220	-	-	-	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-
SW4-TPS-TX240	-	-	-	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-
SW4-TPS-TX240-Plus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
UMX-HDMI-140	-	-	-	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-
UMX-HDMI-140-Plus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
UMX-TPS-TX120, -TX130, -TX140	-	-	-	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-
UMX-TPS-TX140K, TX140-Plus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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