Art-Net II

Specification for the
Art-Net II Ethernet Communication Standard

Artistic Licence

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Comments on Revision Q: There are a number of subtle changes in this revision that may require some minor code changes in products that implement Art-Net. The following is a list of pointers to areas of the document that have changed.

1. The secondary IP address has been changed to a 10.x.x.x. This is an un-routable address.
2. The method of calculating the IP address from the MAC address has been improved.
3. Each packet definition now contains a detailed description of allowed implementation and private versus broadcast reply.
4. Programmable IP addresses added.
5. RDM Support Added
6. Server reply added

Comments on Revision AC:

1. Addition of control fields to define RDM Draft vs RDM std (see light green table marking).
2. Addition of 'Art-Net II' details on how ArtDmx can be Unicast.
3. Added ident bit field to ArtPollReply.
4. Deprecated functions moved to annexe document.
5. Reformatted for A5 booklet.

Comments on Revision AF:

1. ArtRdm table entry 17 incorrectly referenced the DMX start code. The RDM data in this packet excludes the Start Code.

Comments on Revision AG:

1. Numbering error in file format table (page 24) corrected.

Overview:

Art-Net is an Ethernet protocol based on the TCP/IP protocol suite. Its purpose is to allow transfer of large amounts of DMX512 data over a wide area using standard networking technology. Art-Net is primarily intended to operate over 10BaseT networks.

The latest revision of the protocol implements a number of new features and also simplifies the data transfer mechanism. The changes are all based on feed back from manufacturers who are using the protocol.

Limitations:

A theoretical limit of 255 universes of DMX512 exists in this specification. However a simplistic data rate comparison (DMX runs at 250KBaud, 10BaseT at 10MBaud) suggests a maximum of 40 universes of DMX is the limit. Art-Net uses a simple delta transmission compression technique that will provide about 40 universes. If an installation of more than say 30 universes is contemplated, then it is necessary to use the unicast features of Art-Net II and 100BaseT or better physical layer. If this is done the number of universes limit becomes purely related to the network bandwidth.

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Terminology:

- Node: A device that translates DMX512 to or from Art-Net is referred to as a Node.
- Universe: A single DMX512 frame of 512 channels is referred to as a Universe.
- Sub-Net: A group of 16 consecutive universes is referred to as a sub-net. (Not to be confused with the subnet mask).
- A central controller or monitoring device (lighting console) is referred to as a Server.
- IP: The IP is the Internet protocol address. It is expressed in either a long word format (0x12345678) or dot format (2.255.255.255). Convention is that the former is hexadecimal and the latter is decimal. The IP uniquely identifies any Nodes or Servers on a network.
- Subnet Mask: Defines which part of the IP represents the Network address and which part represents the Node address. All Art-Net implementations require a Sub-Net mask of 255.0.0.0. This means that the first byte of the IP is the network address and the remaining three bytes are the Node address.
- Port: Actual data transmission on Art-Net uses the UDP protocol that operates ‘on top of’ the TCP/IP protocol. UDP data transfer operates by transferring data from a specific IP:Port address on a Node or Server to a second specific IP:Port address on a second Node or Server. Art-Net uses only one port address of 0x1936.
- Limited Broadcast: When a network first connects, the Server does not know the number of Nodes on the network, nor does it know their IP addresses. The Limited broadcast address allows the Server to send an ArtPoll to all Nodes on the network.
- Server: A generic term describing an Art-Net device with the primary task of generating control data. For example, a lighting console.
- Node: A generic term describing an Art-Net device with the primary task of receiving control data. For example, a dimmer or an Ethernet to DMX gateway.
- Media Server: A generic term describing an Art-Net device capable of generating control data based on the ‘mx’ Media Extensions to Art-Net.

Ethernet Implementation:

General Notes:

- All communication is UDP. Each packet format defined in this document form the Data field of an enclosing UDP packet.
- Packet formats are specified in a manner similar to C-language structures, in which all data items are considered to be unsigned integers of type INT8, INT16 or INT32 according to the number of bits. There are no hidden padding bytes, except at the very end of a packet, which may be rounded up to a multiple of 2 or 4 bytes. Extra bytes at the end of a valid received packet are ignored.
- The protocols are generalised for handling future versions with increased numbers of ports.
- Many bit data fields contain unused positions. These may be used in future versions of the protocol. They should be transmitted as zero and not tested by receivers.
- All packet definitions are designed such that their length can be increased in future revisions, whilst retaining compatibility. For this reason, only minimum packet length is checked in this protocol.

Protocol Operation:

A Node operates in one mode, each Node having a unique IP address derived from its Ethernet MAC address. The UDP port used as sources and destinations is 0x1936.

IP address configuration

The Art-Net protocol, by default, uses a Class A IP address scheme. This allows Art-Net products to communicate directly and without the need for a DHCP server to be connected to the network. The use of Class A addressing is allowed within a closed network. It is important to ensure that Art-Net data is not routed onto the Internet.

Products implementing Art-Net should default to the Primary IP address of 2.?.?.?.

The IP address consists of a 32 bit number designated as A.B.C.D. The lower the bytes B.C.D is calculated from the MAC address. The high byte 'A' is set to one of two values as shown in the following table.

The MAC address is a 48 bit number designated u:v:w:x:y:z. This is a globally unique number. The upper three bytes 'u.v.w' are registered to a specific organisation. The lower three bytes 'x.y.z' are assigned by that organisation. In order to ensure that there is minimal possibility of IP address conflicts between different manufacturers supporting Art-Net, the product OEM code is added to the MAC address.

The 'B' field of the IP address is calculated by adding the high byte of the OEM code with the low byte of the OEM code and the 'x' field of the MAC address.

On power up, the Node checks its configuration for IP addressing mode. If it has been programmed to use a custom IP address, the following procedure is not used.

	IP Address A.B.C.D				Subnet Mask
Product Switch Settings	A	B	C	D	
Custom IP Programmed	As Programmed				As Programmed
Network Switch Off	2	x+OEM	y	z	255.0.0.0
Network Switch On	10	x+OEM	y	z	255.0.0.0

The sub-net mask is always initialised to 255.0.0.0, unless a custom IP address is in use. This means that the network address is the most significant 8 bits and the Node address is the least significant 24 bits of the IP address. This is a Class A network address and for this reason care must be exercised when connecting to other networks. If an installation requires connection of an Art-Net network to another network that has Internet access, then the connection must be implemented via a router that filters out the Class A addresses.

IP address Example

Given the following settings, the IP address calculation will be as follows:

Network Switch = Off

MAC address = 12.45.78.98.34.76

OEM code = 0x0010

Calculation:

IP Address A = 2 (Because Network switch is off).

IP Address B = 114 (98 + 0 + 16).

IP Address C = 34 (from MAC address).

IP Address D = 76 (from MAC address).

IP Address = 2.114.34.76.

Server Default Poll

By default a Server should poll both the primary and secondary Art-Net addresses:

- 2.255.255.255:0x1936 Primary Art-Net Address
- 10.255.255.255:0x1936 Secondary Art-Net Address

Network Topology:

Art-Net allows two network topologies to operate simultaneously:

1. Peer to Peer: This is an unmanaged network where multiple Nodes transfer data without the intervention of a server. All data transfer uses ArtDmx packets. All data is broadcast. This is the power on mode of operation for all Art-Net compliant nodes designed to receive DMX512. In Peer to Peer mode, all IP packets are sent to the limited broadcast address 2.255.255.255 (or 10.255.255.255 depending upon the Network Switch setting), and are therefore received by all Nodes on the same local network.
2. Server to Peer: This is the most sophisticated implementation whereby one or more Nodes communicate with one or more central servers (lighting consoles). This mode of operation data transfer operates by unicast transmission of ArtDmx packets. This topology allows greater than 40 universes to be transferred over a single network.

The Universe Address of each DMX512 Universe is encoded as an 8-bit number. The high nibble is referred to as the Sub-net address and is set to a single value for each Node. The low nibble is used to define the individual DMX512 Universe within the Node.

This means that any Node must have:

1. One front panel “Sub-net” switch.
2. One front panel “Universe” switch for each implemented DMX512 input or output.

Operation

All UDP packets accepted by the Node conform to the Art-Net protocol specification as defined below. Any other packets are ignored.

ArtPoll:

Implementation		
Entity	**Direction**	**Action**
Server	Receive	Send ArtPollReply.
	Unicast Transmit	Server transmits this packet to a specific Server or Node IP address when a single device response is required.
	Broadcast	Server broadcasts this packet to poll all Servers and Nodes on the network.
Node	Receive	Send ArtPollReply.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.
Media Server	Receive	Send ArtPollReply.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.

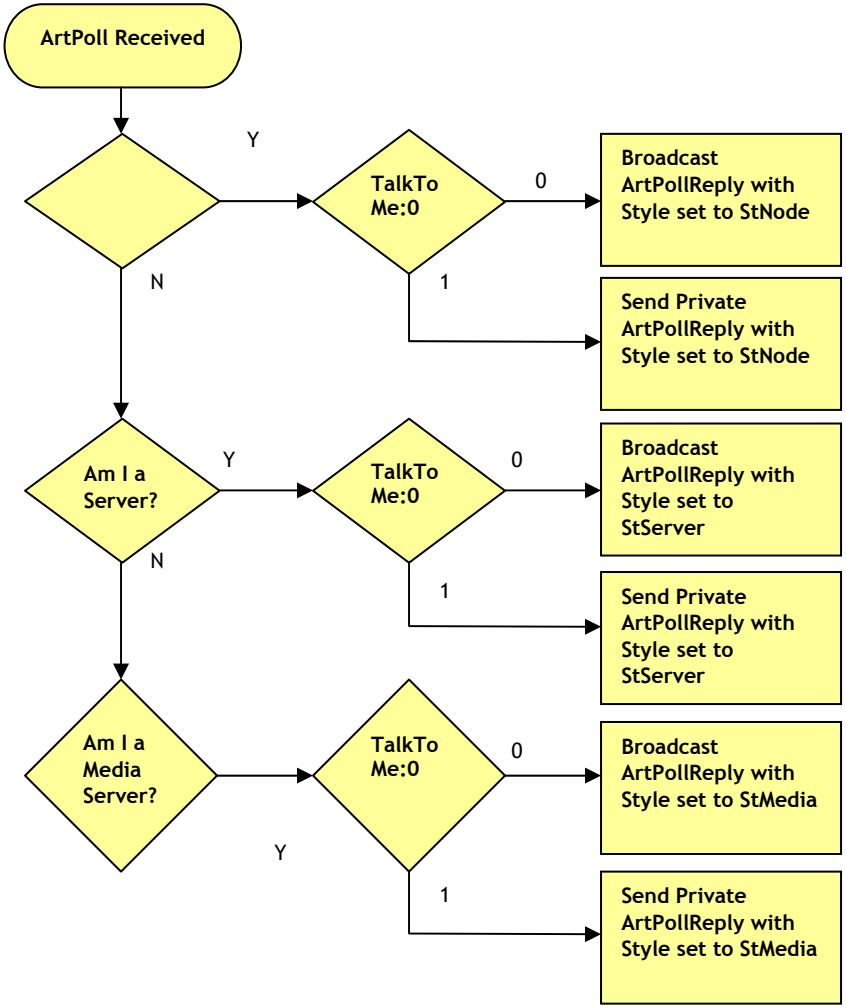
The ArtPoll packet is used to discover the presence of other Servers, Nodes and Media Servers. The ArtPoll packet is only sent by a Server. Both Servers and Nodes respond to the packet.

A Server broadcasts an ArtPoll packet to IP address 2.255.255.255 (sub-net mask 255.0.0.0) at UDP port 0x1936. This is the limited broadcast address:

The Server initially broadcasts ArtPoll in order to discover the presence of other Servers and Nodes on the network. The Server can then choose whether to continue using broadcast, or communicate privately with the detected network devices. (ArtPollReply includes the replier's IP address).

The Server may assume a maximum timeout of 3 seconds between sending ArtPoll and receiving all ArtPollReply packets.

The Server that broadcasts an ArtPoll should also reply to it's own message with an ArtPollReply. This ensures that any other Servers listening to the network will detect all devices without the need for all Servers connected to the network to send ArtPoll packets.



ArtPoll				
Field	**Name**	**Size**	**Bit**	**Description**
1	ID[8]	Int8	-	Array of 8 characters, the final character is a null termination. Value = 'A' 'r' 't' '-' 'N' 'e' 't' 0x00
2	OpCode	Int 16	-	The OpCode defines the class of data following ArtPoll within this UDP packet. Transmitted low byte first. See Table 1 for the OpCode listing. Set to OpPoll.
3	ProtVerH	Int8	-	High byte of the Art-Net protocol revision number.
4	ProtVer	Int8	-	Low byte of the Art-Net protocol revision number. Current value 14. Servers should ignore communication with nodes using a protocol version lower than 14.
5	TalkToMe	Int8	-	Set behaviour of Node
			7-2	Unused, transmit as zero, do not test upon receipt.
			1	0 = Only send ArtPollReply in response to an ArtPoll or ArtAddress.
				1 = Send ArtPollReply whenever Node conditions change. This selection allows the Server to be informed of changes without the need to continuously poll.
			0	0 = Broadcast all further ArtPollReplys.
				1 = Send all future ArtPollReplys to the sender of this packet.
6	Pad	Int8	-	Filler byte to make packet length even.

Table 1 - OpCodes:

The following table details the legal OpCode values used in Art-Net packets:

Opcodes		
Name	**Value**	**Definition**
OpPoll	0x2000	This is an ArtPoll packet, no other data is contained in this UDP packet.
OpPollReply	0x2100	This is an ArtPollReply Packet. It contains device status information.
OpOutput	0x5000	This is an ArtDmx data packet. It contains DMX512 information for a single Universe.
OpAddress	0x6000	This is an ArtAddress packet. It contains remote programming information for a Node.
OpInput	0x7000	This is an ArtInput packet. It contains enable – disable data for DMX inputs.
OpTodRequest	0x8000	This is an ArtTodRequest packet. It is used to request a Table of Devices (ToD) for RDM discovery.
OpTodData	0x8100	This is an ArtTodData packet. It is used to send a Table of Devices (ToD) for RDM discovery.
OpTodControl	0x8200	This is an ArtTodControl packet. It is used to send RDM discovery control messages.
OpRdm	0x8300	This is an ArtRdm packet. It is used to send all non discovery RDM messages.
OpRdmSub	0x8400	This is an ArtRdmSub packet. It is used to send compressed, RDM Sub-Device data.

Opcodes		
Name	**Value**	**Definition**
OpVideoSetup	0xa010	This is an ArtVideoSetup packet. It contains video screen setup information for nodes that implement the extended video features.
OpVideoPalette	0xa020	This is an ArtVideoPalette packet. It contains colour palette setup information for nodes that implement the extended video features.
OpVideoData	0xa040	This is an ArtVideoData packet. It contains display data for nodes that implement the extended video features.
OpMacMaster	0xf000	This is an ArtMacMaster packet. It is used to program the Node's MAC address, Oem device type and ESTA manufacturer code. This is for factory initialisation of a Node. It is not to be used by applications.
OpMacSlave	0xf100	This is an ArtMacSlave packet. It is returned by the node to acknowledge receipt of an ArtMacMaster packet.
OpFirmwareMaster	0xf200	This is an ArtFirmwareMaster packet. It is used to upload new firmware or firmware extensions to the Node.
OpFirmwareReply	0xf300	This is an ArtFirmwareReply packet. It is returned by the node to acknowledge receipt of an ArtFirmwareMaster packet.
OpIpProg	0xf800	This is an ArtIpProg packet. It is used to reprogramme the IP, Mask and Port address of the Node.
OpIpProgReply	0xf900	This is an ArtIpProgReply packet. It is returned by the node to acknowledge receipt of an ArtIpProg packet.
OpMedia	0x9000	This is an ArtMedia packet. It is Unicast by a Media Server and acted upon by a Server.
OpMediaPatch	0x9100	This is an ArtMediaPatch packet. It is Unicast by a Server and acted upon by a Media Server.
OpMediaControl	0x9200	This is an ArtMediaControl packet. It is Unicast by a Server and acted upon by a Media Server.
OpMediaContrlReply	0x9300	This is an ArtMediaControlReply packet. It is Unicast by a Media Server and acted upon by a Server.

Table 2 - OemCode:

The following table details the registered OEM codes. The OEM code defines a specific manufacturer's product type. The OemCode is returned in the ArtPollReply:

Value	Manufacturer	Product	Notes	RDM
0x0000	Artistic Licence	DMX-Hub	4x DMX in, 4x DMX out	×
0x0001	ADB	Netgate	4x DMX in, 4x DMX out	×
0x0002	MA Lighting	DMX-Hub	4x DMX in, 4x DMX out	×
0x0003	Artistic Licence	Ether-Lynx	2x DMX in, 4x DMX out	✓
0x0004	LewLight	Capture v2	TBA	×
0x0005	High End	TBA	TBA	×
0x0006	Avolites	Art 2000	2x DMX in	×
0x0010	Artistic Licence	Down-Link	2x DMX out. Wall Panel.	×
0x0011	Artistic Licence	Up-Link	2x DMX in. Wall Panel.	×
0x0014	Artistic Licence	Net-Link O/P	2x DMX out.	×
0x0015	Artistic Licence	Net-Link I/P	2x DMX in.	×
0x0030	Doug Fleenor	TBA	2x DMX out.	×
0x0031	Doug Fleenor	TBA	2x DMX in.	×
0x0050	Goddard Design	DMX-Link ™ O/P	2x DMX out.	×
0x0051	Goddard Design	DMX-Link ™ I/P	2x DMX in.	×
0x0070	ADB	Net-Port O/P	2x DMX out.	×
0x0071	ADB	Net-Port I/P	2x DMX in.	×

Value	Manufacturer	Product	Notes	RDM
0x0072	ADB	WiFi Remote	WiFi Remote Control	×
0x0073-0x007f	ADB	Reserved		×
0x008c	Zero 88	TBA	2x DMX out.	×
0x008d	Zero 88	TBA	2x DMX in.	×
0x008e	Flying Pig	TBA	2x DMX out.	×
0x008f	Flying Pig	TBA	2x DMX in.	×
0x0090	ELC	ELC 2	2x DMX out.	×
0x0091	ELC	ELC 4	4x DMX in. 4x DMX out.	×
0x0092-0x009f	ELC	Reserved		×
0x0120	Artistic Licence	Pixi-Power F1a	2x DMX out emulated.	✓
0x0180	Martin	Maxxyz	4x DMX in. 4x DMX out.	×
0x0190-0x019f	Enttec	Reserved		×
0x01a0	IES	PBX	1 x DMX in. 1 x DMX out.	×
0x01a1	IES	Executive	2 x DMX in. 2 x DMX out.	×
0x01a2	IES	Matrix	2 x DMX in. 2 x DMX out.	×
0x01a3-0x01af	IES	Reserved		×
0x01b0	EDI	Edig	4x DMX in. 4x DMX out.	×
0x01c0	Nondim Ent	OpenLux	4x DMX in. 4x DMX out.	×
0x01d0	Green Hippo	Hippotizer	Emulates 1x DMX in.	×
0x01e0	VNR	Merger-Booster	4x DMX in. 4x DMX out.	×
0x01f0	Robe	ILE	1x DMX in. 1x DMX out.	×
0x01f1	Robe	ILE Controller	4x DMX in. 4x DMX out.	×
0x0210	Artistic Licence	Down-Lynx RDM	2x DMX out. Wall Panel.	✓
0x0211	Artistic Licence	Up-Lynx RDM	2x DMX in. Wall Panel.	✓
0x0214	Artistic Licence	Net-Lynx O/P RDM	2x DMX out.	✓
0x0215	Artistic Licence	Net-Lynx I/P RDM	2x DMX in.	✓
0x0230	Doug Fleenor	TBA	2x DMX out.	✓
0x0231	Doug Fleenor	TBA	2x DMX in.	✓
0x0250	Goddard Design	DMX-Link ™ O/P	2x DMX out.	✓
0x0251	Goddard Design	DMX-Link ™ I/P	2x DMX in.	✓
0x0270	ADB	Net-Port O/P	2x DMX out.	✓
0x0271	ADB	Net-Port I/P	2x DMX in.	✓
0x0280	LSC	Down-Lynx	2x DMX out.	✓
0x0281	LSC	Up-Lynx	2x DMX in.	✓
0x0300	Golden Stage	DMX-net/O	2x DMX out.	×
0x0301	Golden Stage	DMX-net/I	2x DMX in.	×
0x0302	Golden Stage	TBA		×
0x0303	Golden Stage	TBA		×
0x0304	Golden Stage	GT-96	1 x DMX out.	×
0x0305	Golden Stage	Goldstage III	1 x DMX out	×
0x0306	Golden Stage	TBA		×
0x0307	Golden Stage	TBA		×
0x0308	Golden Stage	KTG-5S	2 x DMX in	×
0x0309-0x030f	Golden Stage	Reserved		×
0x0310	Sunset Dynamics	Star Gate DMX	4 x DMX in, 4 x DMX out	×
0x0320	Luminex Light	DMX8	4 x DMX in, 4 x DMX out	×
0x0321	Luminex Light	DMX2	2 x DMX in, 2 x DMX out	×
0x0330	Invisible Rival	Blue Hysteria	2 x DMX in, 2 x DMX out	×
0x0340	Avolites	Diamond 4 Vision	8 x DMX out	×
0x0341	Avolites	Diamond 4 Elite	8 x DMX out	×
0x0342	Avolites	Pearl Offline	4 x DMX out	×
0x0350	Big Foot	EtherMux Remote	1 x DMX in	×
0x0351	Big Foot	EtherMux Server	1 x DMX in, 1 x DMX out	×
0x0352	Big Foot	EtherMux Desktop	1 x DMX out	×

Value	Manufacturer	Product	Notes	RDM
0x0360	E:Cue	ELink512	1 x DMX out	×
0x0361	E:Cue	ELink1024	2 x DMX out	×
0x0362	E:Cue	ELink2048	4 x DMX out	×
0x0370	Kiss Box	DMX Box 1	1 x DMX in, 1 x DMX out	✓
0x0380	Arkaos	VJD	1 x DMX in	×
0x0390	Digital Enlight-enment	Show Gate	4 x DMX in, 4 x DMX out	×
0x03a0	Des	Neli 6/12/24	1 x DMX in, 1 x DMX out	×
0x03b0	Daslight	SunLight Easy	1 x DMX in, 1 x DMX out	×
0x03b1	Daslight	SunLight Magic 3D	4 x DMX out	×
0x03c0	HES	Catalyst 1	Variable	×
0x03d0	PixelMad	PixelMad 1	Variable	×
0x03e0	LeHigh	Dx2	2 x DMX in, 1 x DMX out	×
0x03f0	Horizon	Horizon Controller	Variable	×
0x0400	Audio Scene	Audio Scene O	2 x DMX out	×
0x0401	Audio Scene	Audio Scene I	2 x DMX in	×
0x0410	Pathport	Pathport 2 Out	2 x DMX out	×
0x0411	Pathport	Pathport 2 In	2 x DMX in	×
0x0412	Pathport	Pathport 1 Out	1 x DMX out	×
0x0413	Pathport	Pathport 1 In	1 x DMX in	×
0x0420	Botex	Botex	2 x DMX in, 2 x DMX out	×
0x0430	Simon Newton	SN ArtNet Lib	4 x DMX in, 4 x DMX out	×
0x0431	Simon Newton	SN LLA Live	4 x DMX in, 4 x DMX out	×
0x0440	XLNT	DMX Input Node	1 x DMX in	×
0x0441	XLNT	DMX Output Node	2 x DMX in	×
0x0450	Schnick-Schnack-Systems	SSS 4E	4 x DMX out	×
0x0460	Dom Dv	Net DMX	1 DMX in or 1 DMX out	×
0x0470	Sean Christopher	Projection Pal	1 x DMX in	✓
0x0471	Sean Christopher	The Lighting Remote	4 x DMX in, 4 x DMX out	×
0x0472	LSS Lighting	Master Gate	Profi Bus Interface	×
0x0473	LSS Lighting	Rail Controller	Profi Bus Interface	×
0x0490-0x049f	Open Clear	Reserved		
0x04b0	MA Lighting	2 Port Node	2 x DMX in or 2 x DMX out	×
0x04b1	MA Lighting	Network Signal Processor	Variable	×
0x04b2	MA Lighting	Network Dimmer Processor	Variable	×
0x04b3	MA Lighting	Network Remote	1 x DMX out	×
0x04b4-0x04bf	MA Lighting	Reserved		×
0x04c0	Inoage	Madrix 1	1 x DMX out	×
0x04d0	Xilver	Controller	1 x DMX out	×
0x04e0	Wybron	Ethernet PSU	2 x DMX out	✓
0x8000	ADB	Netgate XT	Video output and trigger inputs	×
0x8001	Artistic Licence	Net-Patch	TBA	
0x8002	Artistic Licence	DMX-Hub XT	Video output and trigger inputs	×
0x8003	Artistic Licence	Four-Play	Real time data record - playback	×
0x00ff	---	---	Development code. Not to be used in production products.	

Table 3 - NodeReport Codes:

The following table details the NodeReport codes. TheNodeReport code defines generic error, advisory and status messages for both Nodes and Servers. The NodeReport is returned in both the ArtPollReply and ArtPollServerReply:

Code	Mnemonic	Description
0x0000	RcDebug	Booted in debug mode (Only used in development)
0x0001	RcPowerOk	Power On Tests successful
0x0002	RcPowerFail	Hardware tests failed at Power On
0x0003	RcSocketWr1	Last UDP from Node failed due to truncated length, Most likely caused by a collision.
0x0004	RcParseFail	Unable to identify last UDP transmission. Check OpCode and packet length.
0x0005	RcUdpFail	Unable to open Udp Socket in last transmission attempt
0x0006	RcShNameOk	Confirms that Short Name programming via ArtAddress, was successful.
0x0007	RcLoNameOk	Confirms that Long Name programming via ArtAddress, was successful.
0x0008	RcDmxError	DMX512 receive errors detected.
0x0009	RcDmxUdpFull	Ran out of internal DMX transmit buffers.
0x000a	RcDmxRxFull	Ran out of internal DMX Rx buffers.
0x000b	RcSwitchErr	Rx Universe switches conflict.
0x000c	RcConfigErr	Product configuration does not match firmware.
0x000d	RcDmxShort	DMX output short detected. See GoodOutput field.
0x000e	RcFirmwareFail	Last attempt to upload new firmware failed.
0x000f	RcUserFail	User changed switch settings when address locked by remote programming. User changes ignored.

Table 4 - Style Codes:

The following table details the Style codes. The Style code defines the general functionality of a Server. The Style code is returned in ArtPollReply.

Code	Mnemonic	Description
0x00	StNode	A DMX to / from Art-Net device
0x01	StServer	A lighting console.
0x02	StMedia	A Media Server.
0x03	StRoute	A network routing device.
0x04	StBackup	A backup device.
0x05	StConfig	A configuration or diagnostic tool.

ArtPollReply:

Implementation		
Entity	**Direction**	**Action**
All devices	Receive	No Art-Net action.
	Unicast Transmit	Transmits this packet to a specific Server IP address, in response to an ArtPoll, if the TalkToMe field is '1'.
	Broadcast	Broadcasts this packet in response to an ArtPoll if the TalkToMe field is '0'.

A device, in response to a Server's ArtPoll, sends the ArtPollReply. The 'TalkToMe' field in the ArtPoll packet can modify this default mode of operation. This packet is also broadcast by all Art-Net devices on power up.

ArtPollReply				
Field	**Name**	**Size**	**Bit**	**Description**
1	ID[8]	Int8	-	Array of 8 characters, the final character is a null termination. Value = 'A' 'r' 't' '-' 'N' 'e' 't' 0x00
2	OpCode	Int16	-	OpPollReply Transmitted low byte first.
3	IP Address[4]	Int8	-	Array containing the Node's IP address. First array entry is most significant byte of address.
4	Port	Int16	-	The Port is always 0x1936 Transmitted low byte first.
5	VersInfoH	Int8	-	High byte of Node's firmware revision number. The Server should only use this field to decide if a firmware update should proceed. The convention is that a higher number is a more recent release of firmware.
6	VersInfo	Int8	-	Low byte of Node's firmware revision number.
7	SubSwitchH	Int8	-	The high byte of the Node's Subnet Address. This field is currently unused and set to zero. It is provided to allow future expansion.
8	SubSwitch	Int8	-	The low byte of the Node's Sub-net Address. This is the variable that addresses a Node within Art-Net. In the Ether-Lynx and Netgate products, the front panel Sub-net 'switch' sets this field.
9	OemHi	Int8	-	The high byte of the Oem value.
10	Oem	Int8	-	The low byte of the Oem value. The Oem word describes the equipment vendor and the feature set available. Bit 15 high indicates extended features available. Current registered codes are defined in Table 2.
11	Ubea Version	Int8	-	This field contains the firmware version of the User Bios Extension Area (UBEA). If the UBEA is not programmed, this field contains zero.
12	Status1	Int8	-	General Status register containing bit fields as follows.
			7-6	Indicator state.
				00 Indicator state unknown.
				01 Indicators in Locate Mode.
				10 Indicators in Mute Mode.
				11 Indicators in Normal Mode.
			5-4	Universe Address Programming Authority
				00 Universe Programming Authority unknown.
				01 Set by front panel controls.
				10 Programmed by network.
				11 Not used.
			3	Not implemented, transmit as zero, receivers do not test.
			2	0 = Normal firmware boot (from flash). Nodes that do not support dual boot, clear this field to zero.
				1 = Booted from ROM.
			1	0 = Not capable of Remote Device Management (RDM).
				1 = Capable of Remote Device Management (RDM).
			0	0 = UBEA not present or corrupt
				1 = UBEA present

ArtPollReply				
Field	**Name**	**Size**	**Bit**	**Description**
13	EstaMan	Int16	-	The ESTA manufacturer code. These codes are used to represent equipment manufacturer. They are assigned by ESTA. This field can be interpreted as two ASCII bytes representing the manufacturer initials.
14	ShortName [18]	Int8	-	The array represents a null terminated short name for the Node. The Server uses the ArtAddress packet to program this string. Max length is 17 characters plus the null. This is a fixed length field, although the string it contains can be shorter than the field.
15	LongName [64]	Int8	-	The array represents a null terminated long name for the Node. The Server uses the ArtAddress packet to program this string. Max length is 63 characters plus the null. This is a fixed length field, although the string it contains can be shorter than the field.
16	NodeReport [64]	Int8	-	The array is a textual report of the Node's operating status or operational errors. It is primarily intended for 'engineering' data rather than 'end user' data. The field is formatted as: "#xxxx [yyyy..] zzzzz…" xxxx is a hex status code as defined in Table 3. yyyy is a decimal counter that increments every time the Node sends an ArtPollResponse that is not responding to an ArtPoll. This allows the server to monitor event changes in the Node. zzzz is an English text string defining the status. This is a fixed length field, although the string it contains can be shorter than the field.
17	NumPortsH	Int8	-	The high byte of the word describing the number of input or output ports. The high byte is for future expansion and is currently zero.
18	NumPorts	Int8	-	The low byte of the word describing the number of input or output ports. If number of inputs is not equal to number of outputs, the largest value is taken. Zero is an illegal value. The maximum value is 4.
19	PortTypes [4]	Int8	-	This array defines the operation and protocol of each channel. (Ether-Lynx example = 0xc0, 0xc0, 0xc0, 0xc0). The array length is fixed, independent of the number of inputs or outputs physically available on the Node.
			7	Set is this channel can output data from the Art-Net Network.
			6	Set if this channel can input onto the Art-NetNetwork.
			5-0	00000 = DMX512 00001 = MIDI 00010 = Avab 00011 = Colortran CMX 00100 = ADB 62.5 00101 = Art-Net
20	GoodInput [4]	Int8	-	This array defines input status of the node.
			7	Set – Data received.
			6	Set – Channel includes DMX512 test packets.
			5	Set – Channel includes DMX512 SIP's.
			4	Set – Channel includes DMX512 text packets.

ArtPollReply				
Field	**Name**	**Size**	**Bit**	**Description**
			3	Set – Input is disabled.
			2	Set – Receive errors detected.
			1-0	Unused and transmitted as zero.
21	GoodOutput [4]	Int8	-	This array defines output status of the node.
			7	Set – Data is being transmitted.
			6	Set – Channel includes DMX512 test packets.
			5	Set – Channel includes DMX512 SIP's.
			4	Set – Channel includes DMX512 text packets.
			3	Set – Output is merging ArtNet data.
			2	Set – DMX output short detected on power up
			1	Set – Merge Mode is LTP.
			0	Unused and transmitted as zero.
22	Swin [4]	Int8	-	This array defines the 8 bit Universe address of the available input channels. In DMX-Hub and Netgate, the high nibble is identical to the data held in the low nibble of Subswitch. The low nibble corresponds to the front panel selector for each channel.
23	Swout [4]	Int8	-	This array defines the 8 bit Universe address of the available output channels. In DMX-Hub and Netgate, the high nibble is identical to the data held in the low nibble of Subswitch. The low nibble corresponds to the front panel selector for each channel.
24	SwVideo	Int8	-	Set to 00 when video display is showing local data. Set to 01 when video is showing ethernet data.
25	SwMacro	Int8	-	If the Node supports macro key inputs, this byte represents the trigger values. The Node is responsible for 'debouncing' inputs. When the ArtPollReply is set to transmit automatically, (TalkToMe Bit 1), the ArtPollReply will be sent on both key down and key up events. However, the Server should not assume that only one bit position has changed. The Macro inputs are used for remote event triggering or cueing. Bit fields are active high.
			7	Set – Macro 8 active.
			6	Set – Macro 7 active.
			5	Set – Macro 6 active.
			4	Set – Macro 5 active.
			3	Set – Macro 4 active.
			2	Set – Macro 3 active.
			1	Set – Macro 2 active.
			0	Set – Macro 1 active.
26	SwRemote	Int8	-	If the Node supports remote trigger inputs, this byte represents the trigger values. The Node is responsible for 'debouncing' inputs. When the ArtPollReply is set to transmit automatically, (TalkToMe Bit 1), the ArtPollReply will be sent on both key down and key up events. However, the Server should not assume that only one bit position has changed. The Remote inputs are used for remote event triggering or cueing. Bit fields are active high.
			7	Set – Remote 8 active.
			6	Set – Remote 7 active.

ArtPollReply				
Field	**Name**	**Size**	**Bit**	**Description**
			5	Set – Remote 6 active.
			4	Set – Remote 5 active.
			3	Set – Remote 4 active.
			2	Set – Remote 3 active.
			1	Set – Remote 2 active.
			0	Set – Remote 1 active.
27	Spare	Int8		Not used, set to zero
28	Spare	Int8		Not used, set to zero
29	Spare	Int8		Not used, set to zero
30	Style	Int8		The Style code defines the equipment style of the device. See Table 4 for current Style codes.
31	MAC Hi	Int8		MAC Address Hi Byte. Set to zero if node cannot supply this information.
32	MAC	Int8		MAC Address
33	MAC	Int8		MAC Address
34	MAC	Int8		MAC Address
35	MAC	Int8		MAC Address
36	MAC Lo	Int8		MAC Address Lo Byte
37	Filler	32 x 8		Transmit as zero. For future expansion.

ArtIpProg:

Implementation		
Entity	**Direction**	**Action**
Server	Receive	No Action.
	Unicast Transmit	Server transmits to a specific node IP address.
	Broadcast	Not Allowed.
Node	Receive	Reply with ArtIpProgReply.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.
Media Server	Receive	Reply with ArtIpProgReply.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.

The ArtIpProg packet allows the IP settings of a Node to be reprogrammed.

The ArtIpProg packet is sent by a Server to the private address of a Node. If the Node supports remote programming of IP address, it will respond with an ArtIpProgReply packet. In all scenarios, the ArtIpProgReply is sent to the private address of the sender.

ArtIpProg				
Field	**Name**	**Size**	**Bit**	**Description**
1	ID[8]	Int8	-	Array of 8 characters, the final character is a null termination. Value = 'A' 'r' 't' '-' 'N' 'e' 't' 0x00
2	OpCode	Int16	-	OpIpProg Transmitted low byte first.
3	ProtVerH	Int8	-	High byte of the Art-Net protocol revision number.
4	ProtVer	Int8	-	Low byte of the Art-Net protocol revision number. Current value 14
5	Filler1	Int8	-	Pad length to match ArtPoll.
6	Filler2	Int8	-	Pad length to match ArtPoll.

ArtIpProg				
Field	**Name**	**Size**	**Bit**	**Description**
7	Command	Int8	-	Action this packet as follows:
			-	Defines the how this packet is processed. If all bits are clear, this is an enquiry only.
			7	Set to enable any programming.
			6-4	Not used, transmit as zero
			3	Set to return all three parameters to default
			2	Program IP Address
			1	Program Subnet Mask
			0	Program Port
8	Filler4	Int8		Set to zero. Pads data structure for word alignment.
9	ProgIpHi	Int8		IP Address to be programmed into Node if enabled by Command Field
10	ProgIp2	Int8		
11	ProgIp1	Int8		
12	ProgIpLo	Int8		
13	ProgSmHi	Int8		Subnet mask to be programmed into Node if enabled by Command Field
14	ProgSm2	Int8		
15	ProgSm1	Int8		
16	ProgSmLo	Int8		
17	ProgPort Hi	Int8		PortAddress to be programmed into Node if enabled by Command Field
18	ProgPort Lo	Int8		
19	Spare1	Int8		Transmit as zero, receivers don't test.
20	Spare2	Int8		Transmit as zero, receivers don't test.
21	Spare3	Int8		Transmit as zero, receivers don't test.
22	Spare4	Int8		Transmit as zero, receivers don't test.
23	Spare5	Int8		Transmit as zero, receivers don't test.
24	Spare6	Int8		Transmit as zero, receivers don't test.
25	Spare7	Int8		Transmit as zero, receivers don't test.
26	Spare8	Int8		Transmit as zero, receivers don't test.

ArtIpProgReply:

Implementation		
Entity	**Direction**	**Action**
Server	Receive	No Action.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.
Node	Receive	No Action.
	Unicast Transmit	Transmits to specific Server IP address.
	Broadcast	Not Allowed.
Media Server	Receive	No Action
	Unicast Transmit	Transmits to specific Server IP address.
	Broadcast	Not Allowed.

The ArtIpProgReply packet is issued by a Node in response to an ArtIpProg packet. Nodes that do not supports remote programming of IP address do not reply to ArtIpProg packets. In all scenarios, the ArtIpProgReply is sent to the private address of the sender.

Field	Name	Size	Description
1	ID[8]	Int8	Array of 8 characters, the final character is a null

Field	Name	Size	Description
			termination. Value = ‘A’ ‘r’ ‘t’ ‘-‘ ‘N’ ‘e’ ‘t’ 0x00
2	OpCode	Int16	OpIpProgReply Transmitted low byte first.
3	ProtVerH	Int8	High byte of the Art-Net protocol revision number.
4	ProtVer	Int8	Low byte of the Art-Net protocol revision number. (14)
5	Filler1	Int8	Pad length to match ArtPoll.
6	Filler2	Int8	Pad length to match ArtPoll.
7	Filler3	Int8	Pad length to match ArtIpProg.
8	Filler4	Int8	Pad length to match ArtIpProg.
9	ProgIpHi	Int8	IP Address of Node.
10	ProgIp2	Int8	
11	ProgIp1	Int8	
12	ProgIpLo	Int8	
13	ProgSmHi	Int8	Subnet mask of Node.
14	ProgSm2	Int8	
15	ProgSm1	Int8	
16	ProgSmLo	Int8	
17	ProgPort Hi	Int8	Port Address of Node.
18	ProgPort Lo	Int8	
19	Spare1	Int8	Transmit as zero, receivers don’t test.
20	Spare2	Int8	Transmit as zero, receivers don’t test.
21	Spare3	Int8	Transmit as zero, receivers don’t test.
22	Spare4	Int8	Transmit as zero, receivers don’t test.
23	Spare5	Int8	Transmit as zero, receivers don’t test.
24	Spare6	Int8	Transmit as zero, receivers don’t test.
25	Spare7	Int8	Transmit as zero, receivers don’t test.
26	Spare8	Int8	Transmit as zero, receivers don’t test.

IP Address Override:

All Art-Net compatible devices provide a temporary override facility that defeats any non-standard IP address programming.

Setting the Sub-Net switch and all available Universe switches to ‘F’ enables IP override. In IP override mode, the Node ignores all parameters programmed by ArtIpProg commands.

ArtAddress:

Implementation		
Entity	**Direction**	**Action**
Server	Receive	No Action.
	Unicast Transmit	Server transmits to a specific node IP address.
	Broadcast	Not Allowed.
Node	Receive	Reply with ArtPollReply.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.
Media Server	Receive	Reply with ArtPollReply.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.

A Server or monitoring device on the network can reprogram numerous controls of a node remotely. This, for example, would allow the lighting console to re-route DMX512 data at remote locations. This is achieved by sending an ArtAddress packet to the Node’s IP address. (The IP address is returned in the ArtPoll packet). The node replies with an ArtPollReply packet.

Fields 7 to 13 contain the data that will be programmed into the node.

Field	Name	Size	Description		
1	ID[8]	Int8	Array of 8 characters, the final character is a null termination. Value = 'A' 'r' 't' '-' 'N' 'e' 't' 0x00		
2	OpCode	Int16	OpAddress Transmitted low byte first.		
3	ProtVerH	Int8	High byte of the Art-Net protocol revision number.		
4	ProtVer	Int8	Low byte of the Art-Net protocol revision number. Current value 14		
5	Filler1	Int8	Pad length to match ArtPoll.		
6	Filler2	Int8	Pad length to match ArtPoll.		
7	Short Name [18]	Int8	The array represents a null terminated short name for the Node. The Server uses the ArtAddress packet to program this string. Max length is 17 characters plus the null. The Node will ignore this value if the string is null. This is a fixed length field, although the string it contains can be shorter than the field.		
8	Long Name [64]	Int8	The array represents a null terminated long name for the Node. The Server uses the ArtAddress packet to program this string. Max length is 63 characters plus the null. The Node will ignore this value if the string is null. This is a fixed length field, although the string it contains can be shorter than the field.		
9	Swin [4]	Int8	This array defines the low nibble of the Universe address for the available input channels. This corresponds to the front panel selector for each channel. This value is ignored unless bit 7 is high. i.e. to program a switch to value 0x07, send the value as 0x87. Send 0x00 to reset this value to the physical switch setting. Use value 0x7f for no change.		
10	Swout [4]	Int8	This array defines the low nibble of the Universe address for the available output channels. This corresponds to the front panel selector for each channel. This value is ignored unless bit 7 is high. i.e. to program a switch to value 0x07, send the value as 0x87. Send 0x00 to reset this value to the physical switch setting. Use value 0x7f for no change.		
11	SubSwitch	Int8	The low nibble of the Node's Sub-net Address. This is the variable that addresses a Node within Art-Net. This is the DMX-Hub Sub-net switch. This value is ignored unless bit 7 is high. i.e. to program a switch to value 0x07, send the value as 0x87. Send 0x00 to reset this value to the physical switch setting. Use value 0x7f for no change.		
12	SwVideo	Int8	Reserved.		
13	Command	Int8	Node configuration commands:		
			Val	Mnemonic	Action
			0x00	AcNone	No action
			0x01	AcCancel Merge	If Node is currently in merge mode, cancel merge mode upon receipt of next ArtDmx packet. See discussion of merge mode operation.
			0x02	AcLedNormal	The front panel indicators of the Node operate normally.
			0x03	AcLedMute	The front panel indicators of

Field	Name	Size	Description		
					the Node are disabled and switched off.
			0x04	AcLedLocate	Rapid flashing of the Node's front panel indicators. It is intended as an outlet locator for large installations.
			0x05	AcResetRx Flags	Resets the Node's Sip, Text, Test and data error flags. If an output short is being flagged, forces the test to re-run.
			Node configuration commands: Note that Ltp / Htp settings should be retained by the node during power cycling.		
			0x10	AcMergeLtp0	Set DMX Port 0 to Merge in LTP mode.
			0x11	AcMergeLtp1	Set DMX Port 1 to Merge in LTP mode.
			0x12	AcMergeLtp2	Set DMX Port 2 to Merge in LTP mode.
			0x13	AcMergeLtp3	Set DMX Port 3 to Merge in LTP mode.
			0x50	AcMergeHtp0	Set DMX Port 0 to Merge in HTP (default) mode.
			0x51	AcMergeHtp1	Set DMX Port 1 to Merge in HTP (default) mode.
			0x52	AcMergeHtp2	Set DMX Port 2 to Merge in HTP (default) mode.
			0x53	AcMergeHtp3	Set DMX Port 3 to Merge in HTP (default) mode.
			0x90	AcClearOp0	Clear DMX Output buffer for Port 0
			0x91	AcClearOp1	Clear DMX Output buffer for Port 1
			0x92	AcClearOp2	Clear DMX Output buffer for Port 2
			0x93	AcClearOp3	Clear DMX Output buffer for Port 3

ArtDmx:

Implementation		
Entity	**Direction**	**Action**
Server	Receive	Application Specific.
	Unicast Transmit	Preferred. See Note 1.
	Broadcast	Not preferred.
Node	Receive	No Action
	Unicast Transmit	Preferred. See Note 1.
	Broadcast	Not preferred.
Media Server	Receive	No Action
	Unicast Transmit	See Note 1.
	Broadcast	Not Applicable.

ArtDmx is the data packet used to transfer DMX512 data. The format is identical for Node to Server, Node to Node and Server to Node.

The Node normally transmits ArtDmx on the broadcast address. This ensures that peer to peer operation can always occur, even when the network contains a server.

The Data is output through the DMX O/P port corresponding to the Universe setting. In the absence of received ArtDmx packets, each DMX O/P port re-transmits the same frame continuously.

The first complete DMX frame received at each input port is placed in an ArtDmx packet as above and transmitted as an ArtDmx packet containing the relevant Universe parameter. Each subsequent DMX frame containing **new data** (different length or different contents) is also transmitted as an ArtDmx packet.

Nodes do not transmit ArtDmx for DMX512 inputs that have not received data since power on.

However, an input that is active but not changing, will re-transmit the last valid ArtDmx packet at approximately 4-second intervals.

A DMX input that fails, will not continue to transmit ArtDmx data.

Note 1 Broadcast vs Unicast:

The default is to broadcast ArtDmx packets. However significant network efficiency gains can be achieved by unicasting ArtDmx. When ArtDmx is Unicast, the following rules must be used:

The transmitting device must regularly ArtPoll the network to detect any change in universe switch settings. If the transmitting device opts to Unicast, then it must Unicast ArtDmx to all nodes that are subscribed (In the ArtPollReply) to that universe.

If there are no subscribers to a universe that the transmitter wishes to send, then the ArtDmx may be broadcast. Implementers should provide for dynamic change between Unicast and broadcast. If the number of universe subscribers exceeds a given number, it may become more efficient to broadcast. **Use of unicast only is mandatory for systems using greater that 30 universes.**

ArtDmx				
Field	**Name**	**Size**	**Bit**	**Description**
1	ID[8]	Int8	-	Array of 8 characters, the final character is a null termination. Value = 'A' 'r' 't' '-' 'N' 'e' 't' 0x00
2	OpCode	Int16	-	OpOutput Transmitted low byte first.
3	ProtVerH	Int8	-	High byte of the Art-Net protocol revision number.
4	ProtVer	Int8	-	Low byte of the Art-Net protocol revision number. Current value 14

5	Sequence	Int8	-	The sequence number is used to ensure that ArtDmx packets are used in the correct order. When Art-Net is carried over a medium such as the Internet, it is possible that ArtDmx packets will reach the receiver out of order. This field is incremented in the range 0x01 to 0xff to allow the receiving node to resequence packets. The Sequence field is set to 0x00 to disable this feature.
6	Physical	Int8	-	The physical input port from which DMX512 data was input. This field is for information only. Use Universe for data routing.
7	Universe	Int16	-	The high byte is currently set to zero. The low byte is the address of this Universe of data. In DMX-Hub, the high nibble is the Sub-net switch and the low Nibble is the Universe address switch. Transmitted low byte first.
8	LengthHi	Int8	-	The length of the DMX512 data array. This value should be an even number in the range 2 – 512. It represents the number of DMX512 channels received. High Byte.
9	Length	Int8	-	The length of the DMX512 data array. This value should be an even number in the range 2 – 512. It represents the number of DMX512 channels received. Low Byte.
10	Data [Length]	Int8	-	An array of DMX512 lighting data.

Refresh Rate:

The ArtDmx packet is intended to transfer DMX512 data. For this reason, the ArtDmx packet for a specific IP Address should not be transmitted at a repeat rate faster than the maximum repeat rate of a DMX packet containing 512 data slots.

Data Merging:

The Art-Net protocol allows multiple nodes or servers to transmit ArtDmx data to the same universe.

A node can detect this situation by comparing the IP addresses of received ArtDmx packets. If ArtDmx packets addressed to the same Universe are received from different IP addresses, a potential conflict exists.

The Node can legitimately handle this situation using one of two methods:

- Consider this to be an error condition and await user intervention.
- Automatically merge the data.

Nodes should document the approach that is implemented in the product user guide. The Merge option is preferred as it provides a higher level of functionality.

Merge is implemented in either LTP or HTP mode as specified by the ArtAddress packet.

Merge mode is implemented as follows:

1. If ArtDmx is received from differing IP addresses, the data is HTP merged to the DMX output. In this situation, *ArtPollReply-GoodOutput-Bit3* is set. If *Art-Poll-TalkToMe Bit 1* is set, an ArtPollReply should be transmitted when merging commences.
2. Exit from Merge mode is handled as follows:
    - If *ArtAddress AcCancelMerge* is received, the Next ArtDmx message received ends Merge mode. The Node then discards any ArtDmx packets received from an IP address that does not match the IP address of the ArtDmx packet that terminated Merge mode.

- If either (but not both) sources of ArtDmx stop, the failed source is held in the merge buffer for 10 seconds. If, during the 10 second timeout, the failed source returns, Merge mode continues. If the failed source does not recover, at the end of the timeout period, the Node exits Merge mode.
- If both sources of ArtDmx fail, the output holds the last merge result.

Merging is limited to two sources, any additional sources will be ignored by the Node.

The Merge implementation allows for the following two key modes of operation.

- Combined Control: Two Servers (Consoles) can operate on a network and merge data to multiple Nodes.
- Backup: One Server (Console) can monitor the network for a failure of the primary Server. If a failure occurs, it can use the *ArtAddress AcCancelMerge* command to take instant control of the network.

When a node provides multiple DMX512 inputs, it is the responsibility of the Node to handle merging of data. This is because the Node will have only one IP address. If this were not handled at the Node, ArtDmx packets with identical IP addresses and identical universe numbers, but conflicting level data would be transmitted to the network.

ArtInput:

Implementation		
Entity	**Direction**	**Action**
Server	Receive	No Action.
	Unicast Transmit	Server transmits to a specific node IP address.
	Broadcast	Not Allowed.
Node	Receive	Reply with ArtPollReply.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.
Media Server	Receive	Reply with ArtPollReply.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.

A Server or monitoring device on the network can enable or disable individual DMX512 inputs on any of the network nodes. This allows the Server to directly control network traffic and ensures that unused inputs are disabled and therefore not wasting bandwidth.

All nodes power on with all inputs enabled.

Caution should be exercised when implementing this function in the server. Keep in mind that some network traffic may be operating on a node to node basis.

ArtInput				
Field	**Name**	**Size**	**Bit**	**Description**
1	ID[8]	Int8	-	Array of 8 characters, the final character is a null termination. Value = 'A' 'r' 't' '-' 'N' 'e' 't' 0x00
2	OpCode	Int16	-	OpInput Transmitted low byte first.
3	ProtVerH	Int8	-	High byte of the Art-Net protocol revision number.
4	ProtVer	Int8	-	Low byte of the Art-Net protocol revision number. Current value 14
5	Filler1	Int8	-	Pad length to match ArtPoll.
6	Filler2	Int8	-	Pad length to match ArtPoll.
7	NumPortsH	Int8	-	The high byte of the word describing the number of

ArtInput				
Field	**Name**	**Size**	**Bit**	**Description**
				input or output ports. The high byte is for future expansion and is currently zero.
8	NumPorts	Int8	-	The low byte of the word describing the number of input or output ports. If number of inputs is not equal to number of outputs, the largest value is taken. Zero is an illegal value. The maximum value is 4.
9	Input [4]	Int8	-	This array defines input disable status of each channel. (DMX-Hub example = 0x01, 0x00, 0x01, 0x00 to disable first and third inputs)
			7-1	Not currently used
			0	Set to disable this input.

Firmware and UBEA upgrades:

This section defines the packets used to send firmware revisions to a node. In all instances, communication is private. Under no circumstances should the broadcast address be used.

The transaction involves the server sending multiple ArtFirmwareMaster packets to a Node's IP address. Each packet is acknowledged by the Node with an ArtFirmwareReply.

The server allows a 20 second maximum delay for reception of the ArtFirmwareReply.

If the reply is not received in this time, the server aborts the transaction. The large time period is to allow for Nodes that are writing directly to slow non-volatile memory.

The Node allows a 20 second delay between sending an ArtFirmwareReply and receipt of the next consecutive ArtFirmwareMaster. If the next consecutive block is not received within this time, the Node aborts the transaction. In this instance the Node returns to it's previous operating system and sets ArtPollReply->Status and ArtPollReply ->NodeReport accordingly.

The firmware update file contains a header that defines the Node OEM values that are valid for this update. The Server must check this value before sending to a Node. The Node also checks this data on receipt of the first packet. If the Node receives a packet with an invalid code, it sends an error response.

The UBEA is the User Bios Expansion Area. This is a limited firmware upload mechanism that allows third party firmware extensions to be added to a Node.

Manufacturers who implement this feature must document the software interface requirements.

ArtFirmwareMaster:

Implementation		
Entity	**Direction**	**Action**
Server	Receive	No Action.
	Unicast Transmit	Server transmits to a specific node IP address.
	Broadcast	Not Allowed.
Node	Receive	Reply with OpFirmwareReply.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.
Media Server	Receive	Reply with OpFirmwareReply.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.

ArtFirmwareMaster						
Field	**Name**	**Size**	**Bit**	**Description**		
1	ID[8]	Int8	-	Array of 8 characters, the final character is a null termination. Value = 'A' 'r' 't' '-' 'N' 'e' 't' 0x00		
2	OpCode	Int16	-	OpFirmwareMaster. Transmitted low byte first.		
3	ProtVerH	Int8	-	High byte of the Art-Net protocol revision number.		
4	ProtVer	Int8	-	Low byte of the Art-Net protocol revision number. Current value 14		
5	Filler1	Int8	-	Pad length to match ArtPoll.		
6	Filler2	Int8	-	Pad length to match ArtPoll.		
7	Type	Int8	-	Defines the packet contents as follows:		
				Value	Mnemonic	Function
				0x00	FirmFirst	The first packet of a firmware upload.
				0x01	FirmCont	A consecutive continuation packet of a firmware upload.
				0x02	FirmLast	The last packet of a firmware upload.
				0x03	UbeaFirst	The first packet of a UBEA upload.
				0x04	UbeaCont	A consecutive continuation packet of a UBEA upload.
				0x05	UbeaLast	The last packet of a UBEA upload.
8	BlockId	Int8	-	Counts the consecutive blocks of firmware upload. Starting at 0x00 for the FirmFirst or UbeaFirst packet.		
9	Firmware Length3	Int8	-	The total number of words (Int32) in the firmware upload plus the firmware header size. Eg a 32K word upload plus 530 words of header information == 0x00008212. This value is also the file size (in words) of the file to be uploaded.		
10	Firmware Length2	Int8	-			
11	Firmware Length1	Int8	-			
12	Firmware Length0	Int8	-	LSB		
13	Spare[20]	Int8	-	Server sets to zero, Node does not test.		
14	Data[512]	Int16	-	This array contains the firmware or UBEA data block. The order is hi byte first. The interpretation of this data is manufacturer specific.		

ArtFirmwareReply:

Implementation		
Entity	**Direction**	**Action**
Server	Receive	Send next OpFirmwareMaster.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.
Node	Receive	No Action.
	Unicast Transmit	Node transmits to a specific Server IP address.
	Broadcast	Not Allowed.
Media Server	Receive	No Action.
	Unicast Transmit	Node transmits to a specific Server IP address.
	Broadcast	Not Allowed.

This packet is sent by the Node to the Server in acknowledgement of each OpFirmwareMaster packet.

ArtFirmwareReply						
Field	Name	Size	Bit	Description		
1	ID[8]	Int8	-	Array of 8 characters, the final character is a null termination. Value = 'A' 'r' 't' '-' 'N' 'e' 't' 0x00		
2	OpCode	Int16	-	OpFirmwareReply. Transmitted low byte first.		
3	ProtVerH	Int8	-	High byte of the Art-Net protocol revision number.		
4	ProtVer	Int8	-	Low byte of the Art-Net protocol revision number. Current value 14		
5	Filler1	Int8	-	Pad length to match ArtPoll.		
6	Filler2	Int8	-	Pad length to match ArtPoll.		
7	Type	Int8	-	Defines the packet contents as follows. Codes are used for both firmware and UBEA.		
				Value	Mnemonic	Function
				0x00	FirmBlockGood	Last packet received successfully.
				0x01	FirmAll Good	All firmware received successfully.
				0xff	FirmFail	Firmware upload failed. (All error conditions).
8	Spare[21]	Int8	-	Node sets to zero, Server does not test.		

Firmware File Format:

All firmware and UBEA upload files should be of the following format.

The firmware file extension is .alf.

The UBEA file extension is .alu.

Byte	Name	Description
1	ChecksumHi	This is a 16 bit, one's compliment checksum of the firmware data area.
2	ChecksumLo	LSB of above
3	VersInfoHi	High byte of Node's firmware revision number. The Server should only use this field to decide if a firmware update should proceed. The convention is that a higher number is a more recent release of firmware.
4	VersInfoLo	LSB of above

Byte	Name	Description
5-34	UserName	30 byte field of user name information. This information is not checked by the Node. It is purely for display by the Server. It should contain a human readable description of file and version number. Whilst this is a fixed length field, it must contain a null termination.
35-546	Oem[256]	An array of 256 words. Each word is hi byte first and represents an Oem code for which this file is valid. Unused entries must be filled with 0xffff.
547-1054	Spare[254]	An array of 254 words. Currently unused and should be set to zero.
1055	Length3	The total length in words of the firmware information following this field.
1056	Length2	
1057	Length1	
1058	Length0	LSB
1059	Data[]	The firmware data as an array of 16 bit values ordered hi byte first. The actual data is manufacturer specific.

RDM Support:

This section defines the packet structure used to gate the Remote Device Management (RDM) protocol across Art-Net. It is assumed that the reader is familiar with the RDM document.

Art-Net devices support RDM as follows:

- All RDM discovery commands are proxied; Art-Net devices hold local RDM device lists and conduct their own discovery.
- All RDM Get / Set commands are non-proxied; they are passed to end devices for response.

This document defines the following terms:

- **Input Gateway:** A device that inputs DMX512 onto the Art-Net network (e.g. Up-Lynx).
- **Output Gateway:** A device that outputs DMX512 from the Art-Net network (e.g. Down-Lynx)
- **Table of Devices (TOD):** The list of RDM devices maintained by both Input and Output Gateways.

RDM Discovery

Output Gateway Operation

Output Gateways perform RDM discovery independent of network operation. This includes full discovery upon power-on and incremental discovery as a background task. The Output Gateway informs the network about its TOD as follows:

- Upon receipt of an ArtTodRequest packet, the Output Gateway broadcasts an ArtTodData packet containing the entire TOD. All Input Gateways parse the ArtTodData packets. If the Sub-Net and Universe fields match, the Input Gateway adds the TOD contents to their own internal TOD. This allows Input Gateways to respond to any RDM discovery commands they receive.
- Upon completion of initial RDM discovery, Output Gateways broadcast their TOD in an ArtTodData packet.
- When an RDM device is added to or removed from the Output Gateway's TOD (during incremental discovery), an ArtTodData packet is broadcast automatically.

Input Gateway Operation

Input Gateways generate a TOD by monitoring Art-Net traffic. The TOD is then used to reply to RDM discovery commands by proxy. Operation is as follows:

- Upon power-on, Input Gateways broadcast an ArtTodRequest packet.
- The network is monitored for ArtTodData packets. If the Sub-Net and Universe fields match, the Input Gateway adds the TOD contents to its own internal TOD. This allows Input Gateways to respond to any RDM discovery commands they receive.
- Input Gateways do not transmit any RDM discovery messages to the network.

Server Operation:

Servers emulate the operation of Input Gateways.

ArtTodRequest:

This packet is used to request the Table of RDM Devices (TOD). A Node receiving this packet must not interpret it as forcing full discovery. Full discovery is only initiated at power on or when an ArtTodControl.AtcFlush is received.

Implementation		
Entity	**Direction**	**Action**
Server	Receive	No Action.
	Unicast Transmit	Not Allowed.
	Broadcast	Server broadcasts to all nodes.
Node Output Gateway	Receive	Reply with ArtTodData.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.
Node Input Gateway	Receive	No Action.
	Unicast Transmit	Not Allowed.
	Broadcast	Input Gateway broadcasts to all nodes.
Media Server	Receive	No Action.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.

ArtTodRequest				
Field	**Name**	**Size**	**Bit**	**Description**
1	ID[8]	Int8	-	Array of 8 characters, the final character is a null termination. Value = 'A' 'r' 't' '-' 'N' 'e' 't' 0x00
2	OpCode	Int16	-	OpTodRequest. Transmitted low byte first.
3	ProtVerH	Int8	-	High byte of the Art-Net protocol revision number.
4	ProtVer	Int8	-	Low byte of the Art-Net protocol revision number. Current value 14
5	Filler1	Int8	-	Pad length to match ArtPoll.
6	Filler2	Int8	-	Pad length to match ArtPoll.
7	Spare1	Int8	-	Transmit as zero, receivers don't test.
8	Spare2	Int8	-	Transmit as zero, receivers don't test.
9	Spare3	Int8	-	Transmit as zero, receivers don't test.
10	Spare4	Int8	-	Transmit as zero, receivers don't test.
11	Spare5	Int8	-	Transmit as zero, receivers don't test.
12	Spare6	Int8	-	Transmit as zero, receivers don't test.
13	Spare7	Int8	-	Transmit as zero, receivers don't test.
14	Spare8	Int8	-	Transmit as zero, receivers don't test.

ArtTodRequest						
Field	**Name**	**Size**	**Bit**	**Description**		
15	Command	Int8	-	Value	Mnemonic	Function
				0x00	TodFull	Send the entire TOD.
				The array size of the Address field. Max value is 32.		
17	Address [AdCount]	Int8	-	This array defines the 8 bit Universe address of the Output Gateway nodes that must respond to this packet. The high nibble is the Sub-Net switch. The low nibble corresponds to the Universe.		

ArtTodData:

Implementation		
Entity	**Direction**	**Action**
Server	Receive	No Action.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.
Node Output Gateway	Receive	No Action.
	Unicast Transmit	Not Allowed.
	Broadcast	Output Gateway always broadcasts this packet.
Node Input Gateway	Receive	No Action.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.
Media Server	Receive	No Action.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.

Field	**Name**	**Size**	**Description**		
1	ID[8]	Int8	Array of 8 characters, the final character is a null termination. Value = 'A' 'r' 't' '-' 'N' 'e' 't' 0x00		
2	OpCode	Int16	OpTodData. Transmitted low byte first.		
3	ProtVerH	Int8	High byte of the Art-Net protocol revision number.		
4	ProtVer	Int8	Low byte of the Art-Net protocol revision number. Current value 14		
5	RdmVer	Int8	Art-Net Devices that only support RDM DRAFT V1.0 set field to 0x00. Devices that support RDM STANDARD V1.0 set field to 0x01.		
6	Port	Int8	Physical Port. Range 1-4.		
7	Spare1	Int8	Transmit as zero, receivers don't test.		
8	Spare2	Int8	Transmit as zero, receivers don't test.		
9	Spare3	Int8	Transmit as zero, receivers don't test.		
10	Spare4	Int8	Transmit as zero, receivers don't test.		
11	Spare5	Int8	Transmit as zero, receivers don't test.		
12	Spare6	Int8	Transmit as zero, receivers don't test.		
13	Spare7	Int8	Transmit as zero, receivers don't test.		
14	Spare8	Int8	Transmit as zero, receivers don't test.		
15	Command Response	Int8	Defines the packet contents as follows. The TodFull command should be used with full RDM discovery. The TodAdd and TodSubtract commands should be used with incremental discovery.		
			Value	Mnemon	Function
			0x00	TodFull	The packet contains the entire

Field	Name	Size	Description		
					TOD or is the first packet in a sequence of packets that contains the entire TOD.
			0xff	TodNak	The TOD is not available.
16	Address	Int8	The 8 bit Universe address of the Output Gateway DMX Port that generated this packet. The high nibble is the Sub-Net switch. The low nibble corresponds to the Universe.		
17	UidTotalHi	Int8	The total number of RDM devices discovered by this Universe.		
18	UidTotalLo	Int8			
19	BlockCount	Int8	The index number of this packet. When UidTotal exceeds 200, multiple ArtTodData packets are used. BlockCount is set to zero for the first packet, and incremented for each subsequent packet containing blocks of TOD information.		
20	UidCount	Int8	The number of UIDs encoded in this packet. This is the index of the following array.		
21	TOD [UidCount]	48 bit	An array of RDM UID.		

ArtTodControl:

Implementation		
Entity	**Direction**	**Action**
Server	Receive	No Action.
	Unicast Transmit	Not Allowed.
	Broadcast	Server broadcasts to all nodes.
Node Output Gateway	Receive	Reply with ArtTodData.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.
Node Input Gateway	Receive	No Action.
	Unicast Transmit	Not Allowed.
	Broadcast	Input Gateway broadcasts to all nodes.
Media Server	Receive	No Action.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.

The ArtTodControl packet is used to send RDM control parameters over Art-Net. The response is ArtTodData.

Field	Name	Size	Description
1	ID[8]	Int8	Array of 8 characters, the final character is a null termination. Value = 'A' 'r' 't' '-' 'N' 'e' 't' 0x00
2	OpCode	Int16	OpTodControl. Transmitted low byte first.
3	ProtVerH	Int8	High byte of the Art-Net protocol revision number.
4	ProtVer	Int8	Low byte of the Art-Net protocol revision number. Current value 14
5	Filler1	Int8	Pad length to match ArtPoll.
6	Filler2	Int8	Pad length to match ArtPoll.
7	Spare1	Int8	Transmit as zero, receivers don't test.
8	Spare2	Int8	Transmit as zero, receivers don't test.
9	Spare3	Int8	Transmit as zero, receivers don't test.
10	Spare4	Int8	Transmit as zero, receivers don't test.

Field	Name	Size	Description		
11	Spare5	Int8	Transmit as zero, receivers don't test.		
12	Spare6	Int8	Transmit as zero, receivers don't test.		
13	Spare7	Int8	Transmit as zero, receivers don't test.		
14	Spare8	Int8	Transmit as zero, receivers don't test.		
15	Command	Int8	Defines the packet action.		
			Value	Mnemonic	Function
			0x00	AtcNone	No action.
			0x01	AtcFlush	The node flushes it's TOD and instigates full discovery.
16	Address	Int8	The 8 bit Universe address of the DMX Port that should action this command.		

ArtRdm:

Implementation		
Entity	**Direction**	**Action**
Server	Receive	No Action.
	Unicast Transmit	Allowed – Preferred .
	Broadcast	Allowed.
Node Output Gateway	Receive	No Action
	Unicast Transmit	Allowed - Preferred.
	Broadcast	Allowed.
Node Input Gateway	Receive	No Action.
	Unicast Transmit	Allowed - Preferred.
	Broadcast	Allowed.
Media Server	Receive	No Action.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.

The ArtRdm packet is used to transport all non-discovery RDM messages over Art-Net.

Field	Name	Size	Description
1	ID[8]	Int8	Array of 8 characters, the final character is a null termination. Value = 'A' 'r' 't' '-' 'N' 'e' 't' 0x00
2	OpCode	Int16	OpRdm. Transmitted low byte first.
3	ProtVerH	Int8	High byte of the Art-Net protocol revision number.
4	ProtVer	Int8	Low byte of the Art-Net protocol revision number. Current value 14
5	RdmVer	Int8	Art-Net Devices that only support RDM DRAFT V1.0 set field to 0x00. Devices that support RDM STANDARD V1.0 set field to 0x01.
6	Filler2	Int8	Pad length to match ArtPoll.
7	Spare1	Int8	Transmit as zero, receivers don't test.
8	Spare2	Int8	Transmit as zero, receivers don't test.
9	Spare3	Int8	Transmit as zero, receivers don't test.
10	Spare4	Int8	Transmit as zero, receivers don't test.
11	Spare5	Int8	Transmit as zero, receivers don't test.
12	Spare6	Int8	Transmit as zero, receivers don't test.

Field	Name	Size	Description		
13	Spare7	Int8	Transmit as zero, receivers don't test.		
14	Spare8	Int8	Transmit as zero, receivers don't test.		
15	Command	Int8	Defines the packet action.		
			Value	Mnemonic	Function
			0x00	ArProcess	Process RDM Packet.
16	Address	Int8	The 8 bit Universe address of the DMX Port that should action this command.		
17	RdmPacket	Int8 [Vari]	The RDM data packet excluding the DMX StartCode.		

ArtRdmSub:

Implementation		
Entity	**Direction**	**Action**
Server	Receive	No Action.
	Unicast Transmit	Yes.
	Broadcast	Not allowed.
Node Output Gateway	Receive	No Action
	Unicast Transmit	Yes.
	Broadcast	Not allowed.
Node Input Gateway	Receive	No Action.
	Unicast Transmit	Yes.
	Broadcast	Not allowed.
Media Server	Receive	No Action.
	Unicast Transmit	Not Allowed.
	Broadcast	Not Allowed.

The ArtRdmSub packet is used to Get, Set, GetResponse and Set Response data to multiple sub-devices within an RDM device. This packet is primarily used by Art-Net devices that proxy or emulate RDM. It offers very significant bandwidth gains over the approach of sending multiple ArtRdm packets.

Please note that this packet was added at the release of Art-Net II. For backwards compatibility it is only acceptable to implement this packet in addition to ArtRdm. It must not be used instead of ArtRdm.

ArtRdmSub			
Field	**Name**	**Size**	**Description**
1	ID[8]	Int8	Array of 8 characters, the final character is a null termination. Value = 'A' 'r' 't' '-' 'N' 'e' 't' 0x00
2	OpCode	Int16	OpRdmSub. Transmitted low byte first.
3	ProtVerH	Int8	High byte of the Art-Net protocol revision number.
4	ProtVer	Int8	Low byte of the Art-Net protocol revision number. Current value 14
5	RdmVer	Int8	Art-Net Devices that only support RDM DRAFT V1.0 set field to 0x00. Devices that support RDM STANDARD V1.0 set field to 0x01.
6	Filler2	Int8	Transmit as zero, receivers don't test.
7	UID	Int8[6]	UID of target RDM device.
8	Spare1	Int8	Transmit as zero, receivers don't test.

ArtRdmSub				
Field	**Name**	**Size**	**Description**	
9	CommandClass	Int8	As per RDM specification. This field defines whether this is a Get, Set, GetResponse, SetResponse.	
10	ParameterId	Int16	As per RDM specification. This field defines the type of parameter contained in this packet.	
11	SubDevice	Int16	Defines the first device information contained in packet. This follows the RDM convention that 0 = root device and 1 = first subdevice.	
12	SubCount	Int16	The number of sub devices packed into packet. Zero is illegal.	
13	Spare2	Int8	Transmit as zero, receivers don't test.	
14	Spare3	Int8	Transmit as zero, receivers don't test.	
15	Spare4	Int8	Transmit as zero, receivers don't test.	
16	Spare5	Int8	Transmit as zero, receivers don't test.	
17	Data	Int16 [Vari]	The size of the data array is defined by the contents of CommandClass and SubCount:	
			CommandClass	Array Size
			Get	0
			Set	SubCount
			GetResponse	SubCount
			SetResponse	0

Display of status:

Most Art-Net compliant equipment will provide some level of status indication. The following format is suggested:

Name	Mnemonic	Colour	Function	
Power	Pow	Red	Normally on, flashes if fault detected.	
Communication	Com	Amber	On if any Art-Net packets detected on network, timeout after 6 seconds.	
DMX512	DMX x	Green	DMX Input	On if good DMX received, Flashing if errors detected. Alternative Start Codes are not errors!
			DMX Output	On if receiving ArtDmx for this output. Timeout after 6 seconds.

Data Integrity:

Art-Net receivers should check one item:

- Compare the ID[8] field

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