

[illegible]

#	Test Name	IP Mode	Sender	Receiver	Setup	Shows	Expected	Result
Pre-Test Setup Verification Testing - Ensures the setup is as described in the test setup diagram.								
0.1	Traceroute	IPv4 Unicast	OS traceroute utility	-	The traceroute command is run on the sender showing the route of packets from the sender to receiver.	That the test setup is as described in the setup diagram.	The traceroute should show only a single hop from the sender to receiver machine with no routers present.	Need Explanation of Results
0.2	Ping	IPv4 Unicast	OS ping utility	-	The ping command is run on the sender to the receiver to show the status of the network in terms of delay and loss.	That the network is sending packets correctly between the machines with delays below the timeout value specified in ANSI E1.31-2016 (E131_NETWORK_DATA_LOSS_TIMEOUT = 2.5 seconds) and no loss.	The ping should show no data loss as these tests assume a perfect network, the delay should be below the timeout value used within the protocol.	Need Explanation of Results
0.3	Check Addresses	IPv4	ipconfig	ipconfig	The sender and receiver test machines run a command to display their assigned addresses.	That the sender and receiver ip addresses are setup as shown on the test setup diagram.	The sender should have an IPv4 192.168.0.2 address, the receiver should have the IPv4 192.168.0.6 address. Both should have a subnet mask of 255.255.255.0.	Need Explanation of Results
0.4	Setup Control sACN viewer	IPv4 Multicast	Avolites Titan	sACN viewer	Avolites titan sends a full universe of DMX zero-startcode data on universe 1 (values increasing from 0 to full to 0), sACN viewer receives and displays the data.	The industry source sending a full universe of data and an external receiver showing the received data. This acts as a control to show the expected output as the implementation receiver isn't involved. It also verifies that the setup itself works so any problems are with the receiver.	The sACN viewer should display the full universe of data from the source with all values listed correctly.	Need Explanation of Results
0.5	Setup Control Vision Visualiser	IPv4 Multicast	Avolites Titan	Vision Visualiser	Avolites titan sends a full universe of DMX zero-startcode data on universe 1 (values increasing from 0 to full to 0), vision visualiser receives the data and visualises it.	The industry source sending a full universe of data and an external receiver showing the received data. This acts as a control to show the expected output as the implementation receiver isn't involved. It also verifies that the setup itself works so any problems are with the receiver.	The sACN viewer should display the full universe of data from the source with all values listed correctly.	Need Explanation of Results
sACN Sender Implementation Interoperability Testing								
1	Simple Data Send	IPv4 Multicast	Implementation	Vision Visualiser	The implementation sender sends a single universe (universe 1) of static data (with a zero startcode and first channels set to 255, rest 0) to the vision visualiser	That the implementation sender can send data to the visualiser industry receiver.	The first three lights on sACN universe 1 should come on at full and stay there. The rest should stay off.	
2	Simple Data Send	IPv4 Multicast	Implementation	sACN viewer	Same as test 1 but with the sACN receiver. Conducted in parallel with test 1 to show receivers side by side.	That the implementation sender can send data to the debug external receiver.	The data readout for sACN universe 1 should show the first three channels at full and the rest zero.	Test-1-Annotated.mkv
3	Two Universes	IPv4 Multicast	Implementation	sACN viewer	The implementation sender sends 2 distinct universe of data (with zero startcode) to universes 1 (all channels 100) and 2 (all channels 255), sACN viewer displays the data output.	That the implementation sender can send data on multiple universes to an industry receiver.	The data readout for sACN universes 1 and 2 should show all channels at 100 for universe 1 and all channels at 255 for universe 2.	Test-3-Annotated.mkv
4	Unicast	IPv4 Unicast	Implementation	sACN viewer	Same as test 3 but using Unicast	That the implementation sender can send data on multiple universes using unicast to an industry receiver.	Same as test 3	Test-4-Annotated.mkv
5	Broadcast	IPv4 Broadcast	Implementation	Vision Visualiser	Same as test 3 but using Broadcast	That the implementation sender can send data on multiple universes using broadcast to an industry receiver.	Same as test 3	Test-5-Annotated.mkv
6	Preview Data	IPv4 Multicast	Implementation	sACN Viewer	Same as test 3 but showing preview data.	That the preview data flag is correctly applied and the data is treated the same otherwise.	The packets should have the preview_data flag set.	Test-6-Annotated.mkv
7	Independent moving channels	IPv4 Multicast	Implementation	Vision Visualiser	The implementation sender starts a predefined sequence where every channel in universe 1 follows a sine wave pattern with each channel offset slightly from the previous. This creates an effect which is commonly used in entertainment lighting referred to as a 'dim chase'.	That the implementation sender can handle sending data where each channel is continuously updating.	The visualiser should show a sine wave pattern moving throughout the fixtures.	Test-7-Annotated.mkv
8	Rapid Changes	IPv4 Multicast	Implementation	Vision Visualiser	The implementation sender starts a predefined sequence where every channel is brought up to 100 briefly and then dropped back down to 0 repeatedly to cause a strobing effect.	That the implementation sender can handle sending data which is rapidly changing.	The visualiser should show all the lighting fixtures turning on and off quickly.	Test-8-Annotated.mkv
9	High data rate	IPv4 Multicast	Implementation	sACN viewer	The implementation sender sends a predefined sequence on 16 universes (chosen to match the limit on the industry sender Avolites Titan) where each universe follows a wave but with a slight offset for each universe.	That the implementation sender can handle sending on the same number of universes simultaneously as a source actually used within real-world industry.	sACN viewer to display all 16 universes working at once with independent distinct values for each. Vision visualiser could not be used for this as the version available only supports 4 universes.	The expected wave is visualised using wolfram alpha in "wave-expected.png"
10	Universe Discovery	IPv4 Multicast	Implementation	sACN viewer	sACN viewer starts with no universes discovered. Then the implementation sender starts up with no universes registered. The sender then registers universe 1, 2, 400 and 5000 with gaps between each to show them appearing in the discovered universe list. Universe 400 is then terminated. The entire sender is then terminated.	That the implementation sender sends universe discovery packets correctly even with no universes registered so that they can be received and used by an industry receiver.	The sACN viewer should initially display no universes as the source is transmitting no universes. The universes should then appear as they are registered. Universe 400 should then be removed from the list on sACN viewer when it is terminated by the source. All the universes/source should then be removed when they are all terminated.	Test-10-Annotated.mkv
11	Stream Termination	IPv4 Multicast	Implementation	sACN Viewer	The implementation sender starts up and sends some arbitrary data to the receiver on universe 1 to verify they are connected. The sender then shuts down and in doing so sends stream termination packets to the receiver on universe 1.	That the implementation sender sends stream termination packets correctly so that they are interoperable/compatible with the industry receiver.	Sacn view should reset the channels within universe 1 as the universe has been terminated.	Test-1-Annotated.mkv
Tests which could not be performed as unsupported by industry implementation								
A	Universe Synchronisation Hold	IPv4 Multicast	Implementation	Vision Visualiser	The implementation sender sends a data packet synchronised to universe 2 with all lighting levels at full. The sender then sends a synchronisation packet to universe 2.	That the implementation sender correctly sends universe synchronisation packets which are compatible with the industry receiver.	The visualiser doesn't show any change in output until the synchronisation packet is sent.	Not possible to test using the industry receiver as universe synchronisation is unsupported. Test is expected to pass based on previous integration tests which show this functionality works.
B	Universe Synchronisation Two Universes	IPv4 Multicast	Implementation	Vision Visualiser	The implementation sender sends data packets with synchronisation address 1 to two universes with the first universe of data bringing one set of lights to full and the second universe of data bringing another set of lights to half. After second period a synchronisation packet is then send with synchronisation address 1.	That the implementation sender correctly sends universe synchronisation packets which are compatible with the industry receiver.	The first two data packets produce no change to the visualiser input initially as they are awaiting the synchronisation packet. Once the synchronisation packet is sent the data packets then both take effect at the same time causing one set of lights to turn on at full brightness and the other set to turn on at half brightness.	Failed, IPv6 not supported by either receiver. Traceroute, Ping and addresses were set correctly as shown in Test IPv6 folder.
C	Traceroute IPv6	IPv6 Unicast	OS traceroute utility	-	-	-	-	Failed, IPv6 not supported by either receiver. Traceroute, Ping and addresses were set correctly as shown in Test IPv6 folder.
	Ping IPv6	IPv6 Unicast	OS ping utility	-	-	-	-	
	Check Addr IPv6	IPv6	ipconfig	ipconfig	-	-	-	
	Setup Control sACN Viewer IPv6	IPv6 Multicast	Avolites Titan	Vision Visualiser	Same setup as IPv4 version (Test 0.4 / 0.5) but using IPv6.	-	-	
D	IPv6 Multicast Two Universes	IPv6 Multicast	Implementation	sACN viewer	Same as test 3 but using IPv6 Multicast.	That the implementation sender can send data on multiple universes using IPv6 multicast to an industry receiver. Test 5 + 6 shows the library works over IPv6.	Same as test 3	Failed, IPv6 not supported by either receiver
E	IPv6 Unicast Two Universes	IPv6 Unicast	Implementation	sACN viewer	Same as test 3 but using IPv6 Unicast.	That the implementation sender can send data on multiple universes using IPv6 unicast to an industry receiver. Test 5 + 6 shows the library works over IPv6.	Same as test 3	Failed, IPv6 not supported by either receiver
Key: OS traceroute utility: The traceroute utility that exists on the sending test machine windows 10 operating system. Run using the command "tracert". OS ping utility: The ping utility that exists on the sending test machine windows 10 operating system. Run using the command "ping". ipconfig: Displays the network configuration of the interfaces on a windows machine, shows the IP that each interface is bound to. Run using the command "ipconfig". Avolites Titan: The industry source implementation used for interoperability testing, further details described in the tools section of the report. The showfile used for each test is included in the "Avolites Titan Test Showfiles" folder. sACN viewer: An industry receiver implementation in the form of a debug tool which receives sACN input and displays information about the received input. Further details in the tools section of the report. Vision Visualiser: An industry receiver implementation in the form of a visualiser which receives sACN input and simulates lighting output. Further details in the tools section of the report. Implementation: The 'demo_sacn' implementation of the sending side of the library written as part of this project. This is the focus of the tests.								
During these tests the visualiser uses a predefined lighting layout that allows easily seeing all the channels of a universe. This layout is described in more detail in the report.								
The choice between sACN and Visualiser to use as the receiver for each test was decided based on which would show the output of the test in the clearest way. This means for checking strict data values sACN is preferred however for checking showing lots of channels changing overtime a visualiser is more effective.								
* For each universe x, x in [1, 16], the range for that universes channels is [x - 1] * 10, x * 10, so for example for universe 7 the expected range is: [7 - 1] * 10, 7 * 10 to [8 * 10, 7 * 10] = [60, 70] so values are expected to be from 60 inclusive to 70 exclusive. ** A universe discovery packet should be sent at least every ANSI E1.31-2016 Appendix A E131_E131_UNIVERSE_DISCOVERY_INTERVAL of 10 seconds and so by waiting 20 seconds it means the source should have sent a packet and it been processed and added to the discovered sources by the receive even accounting for processing delays.								

[illegible]