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IDN-Laser-Tester: A Framework for Detecting and Testing ILDA
Digital Network Consumers for Laser Projection

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Abstract: The ILDA Digital Network (IDN) is a novel protocol family providing digital data transmission for laser projection. While the new standards mainly aim to replace the old analogue signal transmission, the digital streaming concept also enables completely new applications and flexible networked scenarios. Very simple tools are existing to check the old analogue connection. Our demo presents the IDN-Laser-Tester, a new framework that allows for detecting and testing IDN enabled hardware or software in a local network in a user friendly manner from smartphone, tablet or portable computer.

Keywords: Application layer protocols, availability in networking, ILDA Digital Network

1 Introduction to IDN & Motivation of the Demo

Laser shows are widely used for entertainment purposes, e.g. to accompany music performances. A typical laser projector consists of a laser module and a fast-moving mirror system, which deflects the laser beam to create shapes and patterns either on a projection surface or in mid-air when using artificial haze or fog.

The International Laser Display Association (ILDA) defines the de facto technical standards used in both laser show hardware and software. Traditionally, laser projectors are controlled with analogue input signals. The analogue ILDA Standard Projector (ISP, [ILD99], the connector is also called ISP-DB25) was the relevant specification on how to connect laser control interfaces with laser projectors in a vendor-independent way, which is in use for more than two decades (technical specification of 1999). Each laser projector was connected to a control-interface by an analogue cable with DB25 connectors (25 wires carrying the signals for X, Y, colours Red, Green, Blue and others), if necessary over long distances.

The ILDA Digital Network (IDN) Stream Specification is a novel standard to transmit laser show artwork in digital data streams inside a computer network [FPB15]. The digital transmission allows for very flexible setups as opposed to the old analogue interfacing and cabling systems. For example, in previous work we have already shown how an IDN software driver can complement existing laser show software to directly generate IDN streams [Fra15]. These are being sent into the local network with destination to an IDN capable laser projector or a suitable IDN-to-analogue converter for legacy ILDA controlled laser projectors, the so called DexLogic StageMate ISP, cf. [Dex21]: It can generate the analogue laser projector signals for ISP-DB25 from incoming IDN streams. It fully implements the IDN stream specification.

Furthermore, the transmitted IDN streams can easily be received and analysed to help with testing and debugging of laser show systems. The IDN-Toolbox is able to display the received

IDN stream on a 2D computer screen [Fra17]. With the IDN-Laser-VR software, a more authentic approach on virtual laser show visualization from IDN streams using virtual reality (VR) headsets is possible: Using a VR headset, the user can move around in a virtual room with several virtual laser projectors and watch laser show artwork generated by typical laser show software. Even without a VR headset connected, the user will see a 3D preview on the computer screen [FM19].

Another IDN specification is still work in progress: The IDN Discovery Protocol (aka IDN-Hello) describes the protocol for the detection, enumeration and query of IDN-enabled devices. Current IDN hardware and all of our IDN tools already support IDN-Hello discovery.

It is also important to understand the content of the IDN streams. The so-called IDN channel messages contain a sequence of laser projector samples each with values for X and Y coordinates and at least three colours, red, green and blue. A laser projector as IDN consumer would use these sample values to generate the control signals of X and Y mirrors for laser beam deflection and the colour signals (R, G, B) for control of multi-colour laser modules. The sample sequence describes the laser projection in a vector-oriented style, similar to probably known from “connect the dots” puzzles. Exactly those signals for X, Y and R, G, B were already included in the analogue ISP-DB25 connector and were generated by separate control interfaces.

There are tester devices available for the analogue ILDA ISP-DB25 connector, e.g. the so called “ILDA Gem Pocket Laser projector tool” by Stanwax Laser (UK), see [Stan21]. Such a tester can be connected to an ILDA DB25 cable and check with simple RGB-coloured test patterns if the (analogue) connection is working with all necessary signal lines for colours and X/Y laser scanner between the tester device, the ILDA cable and the connected laser projector at the cable’s end.

The new ILDA Digital Network is the digital counterpart of the (old) analogue ISP DB25 connection. The digital transmission in local networks allows for very flexible configuration and placement of all network elements as well as sharing and multiplexing on single network links. This level of flexibility also imposes an increased complexity in the network setup and topology which brings in new sources for errors or faulty configurations.

This brought up the idea to create a simple (digital) IDN-based testing tool and test framework

- To be able to connect the testing tool at different points of attachment to the local network,
- To scan the network for available IDN consumer instances (e.g. real laser projectors or IDN visualization software), and
- To send simple test frames or frame sequences for laser projection to selected IDN consumers

2 Subject of the Demo: The IDN-Laser-Tester

In a complex laser show setup with a lot of IDN consumers (laser projectors) and a possibly complex local network it is useful to test the IDN components independently of the laser show software. Our IDN-Laser-Tester framework uses two components:

Firstly, a server component (a piece of given software) that needs to run “somewhere” in the local IDN network (**several options are discussed below**). Secondly, an off-the-shelf smartphone, tablet, laptop or other computer with a web browser that is used as a client to

control the IDN-Laser-Tester server component via the local network (**two connection options are discussed below**). To prepare the server component, there are these options:

Server option 1: The software can be started in a virtual machine on any computer in the local network. A VirtualBox Appliance is pre-configured to boot a Linux Ubuntu instance and start the IDN-Laser-Tester server automatically - without any user interaction. It then displays a splash screen with instructions about how to connect to the server from the web browser and gives information like the IP address and the IDN-Laser-Tester status.

Alternatively, (**server options 2 a/b**) the software can be installed and executed on a Raspberry Pi, either with a connected display or also in so called headless mode (without display). The Raspberry Pi needs to be connected to the local network with IDN consumers and also starts up the server software after boot.

The server component runs a web server based on NodeJS JavaScript runtime. The NodeJS server is able to trigger the execution of IDN functions implemented in the C programming language. Service discovery (IDN-Hello) can be executed and test frames for laser projection can be sent to selected IDN consumers. Web client interaction is done using the WebSocket protocol. The server also gives feedback to the web client's GUI via this connection.

To connect a client to control the server component via a standard web browser, there are **two connection options: First**, the client can be connected using the available WLAN of the local network. **Second**, if the local network does not offer WLAN access, the Raspberry Pi WLAN is configured in access point mode and offers WLAN connectivity to the client to access and control the IDN-Laser-Tester server component. Furthermore, the Raspberry Pi's Ethernet may be connected to different network points of attachment to identify possible IDN connectivity issues in different segments of the local network. More detailed documentation with a description of all features, some background information, use cases and requirements are given in the public gitlab software repository [LLL21].

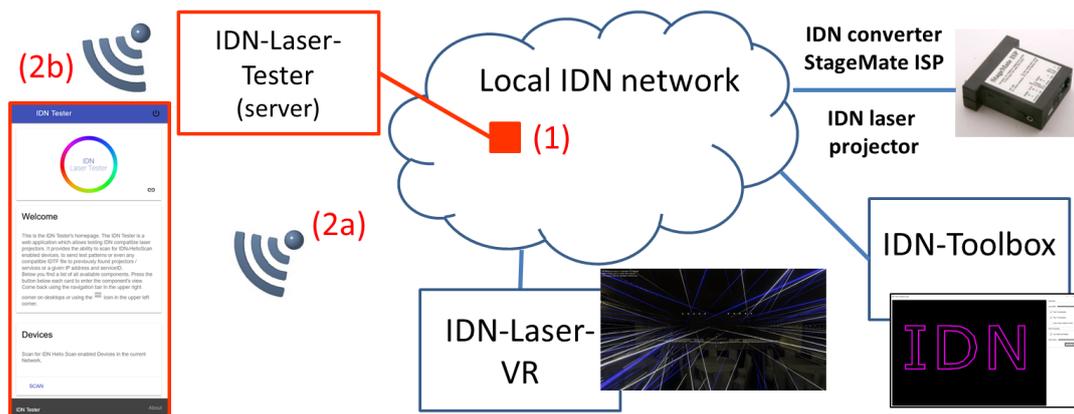


Figure 1: IDN-Laser-Tester system architecture illustration

Figure 1 illustrates the architecture of the IDN-Laser-Tester framework: The local IDN network may have different types of IDN consumers including IDN converters (legacy ISP-DB25 connection), IDN-enabled laser projectors, or IDN visualization software. The components of the IDN-Laser-Tester are outlined in red colour: The server component needs to be connected to the IDN network (mark (1)). The smartphone needs to use an existing

WLAN from the local network (marked as (2a)) or can use the WLAN access point when using the Raspberry Pi setup for the server component (2b).

3 Conclusion

The IDN-Laser-Tester framework is available for free download on gitlab.com and it is even possible to try out and use the IDN-Laser-Tester without IDN hardware and/or laser projector: The IDN-Toolbox or the IDN-Laser-VR visualization software maybe used as IDN consumer, as the most recent versions also implement the IDN service discovery (IDN-Hello) and will be detected by the IDN-Laser-Tester as valid IDN consumer. A short demonstration video on setup and some usage examples are available on the [gitlab](https://gitlab.com) project repository as well as portable (Windows) versions [LLL21].

The IDN-Laser-Tester demonstration will be given in a remote fashion. The output of a real laser projector and the preview of IDN-Toolbox/IDN-Laser-VR will be visible via camera and screen share, and also the controlling side of the IDN-Laser-Tester will be visible using a web browser.

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