A Scintacor White Paper

Laser Safety in Data Centres

How do you ensure engineer and operator safety?

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THE CENTRE OF SCINTILLATION

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Introduction to lasers used within data centres

To constantly process such a large amount of information, data centres use lasers on an enormous scale to transmit information across a wide range of applications.

While they are not the cheapest option, lasers are incredibly energy efficient when transporting data versus electrical equivalents. With sustainability high on the agenda for many data centre operators, achieving net-zero carbon emissions and running on 100% renewable energy is an ambition. Data centres launch a mixture of lasers (some high and some low power) into the same optical fibres.

While many lasers are harmless, some are extremely powerful.

Because of their processing requirements, many data centres use lasers with such a high power (up to 1 watt) that they have the potential to set fire to paper, burn through materials such as wood and plastic, and cause instant, serious harm to people - especially if inadvertently pointed at the eyes.

Data centres & employee safety

As data centres link billions of people together and shapes the technology market with their hosting of digital ventures and flagship enterprises, their global business maintains a responsibility-centred approach. Looking after their people remains at the core of their foundations.

Data centres are large employers based around the world (with up to 3,000 more on-site during construction periods), helping to bring economic opportunities to the local communities. Many staff will relocate to work in the data centres and live with their families nearby the local area, so these data centres seek to positively impact the lives of those living in local communities by investing in local schools, small businesses, non-profits, and development projects.

> *"It is a big undertaking to have thousands of people come onto a site each day to work on complex, high-risk projects and send them home in the evenings without any injuries. We have to maintain that for weeks, months, and years on end, which means that every data centre must be an exceptionally safe, healthy workspace."*

The powerful lasers that run through the cables are invisible. Without the help of specially designed tools, the Network Engineers cannot detect any lasers that might still be active before interacting with the cut cables.

Health risk to network engineers

Most photonic equipment involves several sub-assemblies which must be manually integrated. In data centres experienced and highly trained teams of Network Engineers are responsible for splicing the fibres in the cables before re-routing them and integrating them into the cables. Working on fibre cables containing only low power lasers is not a risk, and allows the datacentre to continue to operate.

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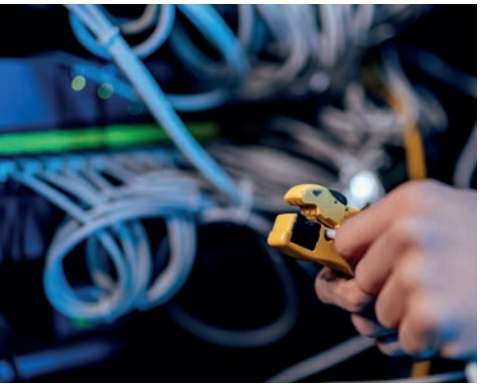

The safety procedures already in place

Data centres already implement Method of Operations Procedures (MOPs) to ensure that the high-powered laser beams are switched off before their Network Engineers begin working on the cables.

These include control-restricted doors that the engineers must physically open to access, and, where possible, the use of tools that clamp onto a fibre to detect the presence of lasers. These tools are highly expensive, large pieces of powered equipment.

Network Engineering teams often report that the clamp style devices are bulky, heavy, unsuitable for use in outdoor environments and confined spaces, and easily damaged. In addition, the cables used in many data centres can consist of thousands of strands, meaning that these clamps designed for 1 to several strands rarely fit all the fibres of a bundle in their entirety.

Even with these MOPs in place, there are concerns that the employees maintaining the network infrastructure are still at a small risk of being exposed to high-power laser radiation that could cause skin burns and eye damage.

Exploring alternative laser detection options

Since the existing clamp style devices were found to be unsuitable, a trial was carried out testing several plastic laser detection cards currently available on the market – including the Visualize Laser Viewing Card by Scintacor. The plastic cards are lightweight, robust, low-cost, and effectively alert the user to otherwise-invisible laser beams in either the Infra-Red or Ultra-violet bands of the spectrum, by emitting a visible glow when exposed to that light source.

However, the trial found that they are not completely suitable for the data centre's specific requirements. The cards cannot discriminate between high or low power lasers and would melt if illuminated by the more powerful lasers that they are trying to detect. These limitations have highlighted the need for a safety product specifically tailored to data centre use.

Network engineer requirements

What was needed was a portable, robust detection tool that was ready for use, easy to use, and could be issued directly to many data centre employees at a reasonable cost.

A lightweight design that could be held up against cut cable fibres from a reasonable physical distance to instantly check for the presence of high-powered lasers operating at > 1400nm wavelength while not detecting safer, lower power, shorter wavelength lasers (to prevent false positives). The device needed to be ready to use and easily carried, for example on a lanyard.

Making the invisible visible

A global data centre operator approached Scintacor in January 2020 to develop a bespoke laser detection tool that would serve as a final safety check within their data centres.

This operator builds and runs many data centres around the world, providing employment for the local communities (with up to 3,000 more people on-site during construction periods).

Data centre fibre optic networks simultaneously transmit vast amounts of information using pulses of laser light from many different lasers. Because the laser radiation is in the infra-red part of the electromagnetic spectrum, it is invisible to the unaided human eye.

Some of these lasers operate at low power and are considered low risk, but some run at higher powers that can cause minor burns to the skin, eye damage and even loss of sight. There is a need for a portable, fail-safe design of laser detector to allow Network Engineers to identify high-powered and harmful lasers when splicing and re-routing server cables.

Scintacor teams conceived the **IRis Safety Wand** – a detector with an Infra-Red Intelligent Scintillator that glows under a specified infrared wavelength range, thus discriminating between harmless low power lasers and the high power lasers that pose a safety risk.

Unlike existing laser detection tools on the market, Scintacor's new product is a lightweight, cost-effective wand that can be worn on a lanyard around the neck alongside an employee's key card.

The Scintacor solution

High-powered lasers in data centres operate at wavelengths longer than 1400nm (in the S, C, L, & U bands).

Our existing IR visualisation range uses a broadband phosphor that will emit visible light when irradiated by 790-840nm, 870-1070nm, and 1500-1590nm Infrared radiation. However, the broad band nature was seen as a source of unwanted false positive indications for this application. To only detect IR lasers operating at above 1400nm, a long-pass filter was chosen to remove unwanted laser beams.

A thick layer of scintillation material using upconverting luminescent mechanism shows whether there is an active IR laser in the fibre optics bundle. Multiple areas can be illuminated simultaneously if more than one fibre actively transmits a laser.

While plastic is used for Scintacor's other detection products, there is a high likelihood the high-power lasers used by data centres would melt the material so alternatives had to be explored. **The new design combines a suitable optical long-pass filter with a phosphor coating on a glass substrate, which detects high-powered laser beams without the detector being damaged.**

A robust anti-reflection coating composed of zirconia and silica applied to the outer glass surface minimises any stray reflections of the incoming laser when it strikes the long-pass filter, giving it less than 2% reflection in the 1100 – 2000nm range. The main body of the wand was designed from a black acrylic that could be produced in a matt finish to help minimise reflections further.

The acrylic housing is easy to hold to help reduce drop risk and withstand any expected potential impacts. The phosphor-coated glass and the long-pass filter are manufactured from inert materials capable of withstanding the expected working environments, such as temperature and humidity variations.

The wand can be easily fixed to a brightly coloured lanyard and worn around the neck, which reduces the likelihood of loss and increases usability. Wearing the wand all day brings about a level of awareness that allows the tool to be used as 'second nature' rather than tucked away in pockets or a bag out of sight. A protective pouch with a soft interior is provided for safe storage when not in use. It is also possible to add a company logo to the product if desired.

Customer trials were carried out using a proof-of-principle prototype, with an active area of 25mm (1") diameter. Network Engineer feedback was positive across the board except for one request - to increase the active area size to accommodate larger fibre bundle diameters. We promptly scaled up to 35mm to cover up to 34mm (1.3") diameter bundles.

Andrew Lee
CTO at Scintacor

"We have had the pleasure of developing our products for many different clients and applications over the years. By delivering a laser detection wand that ticks all the boxes for data centres and helps keep their staff safe, we have an exciting, highly effective product that the whole industry can also benefit from."

“When you drive a car, you have several safety precautions to protect you at every stage of the driving process.

Firstly, you cannot start the car without inserting the key into the ignition. Then you have the brakes to stop the car, and if the brakes fail, there is a seatbelt to protect your body, and if the seatbelts fails, there is an airbag.

The IRis Safety Wand is the airbag equivalent for laser safety.”

What is next for IRis Safety Wand?

The IRis Safety Wand is an innovative, unique invention that will positively impact the data centre industry.

“*High-powered laser applications are used across multiple industries, from telecoms and medical equipment to manufacturing. Any company that orders a product with a high-powered laser should see this wand sitting in the delivery box. It is an elegant, cost-effective solution to a very high-risk safety problem, and we are excited to see what the future holds for this innovative tool.*”
Field Network Engineer

Scintacor has started approaching distributors about the wand at the date of this publication.

IRis is a UK Registered Trademark and the design is currently patent-pending - UK Patent Application No. 2118955.0.

Who is Scintacor?

Scintacor is the world-leading specialist in phosphor and scintillation technologies.

Operating in the industry since the 1920s, we were initially known as Applied Scintillation Technologies and were one of the first producers of phosphors for a variety of X-ray screens. Our heritage has always influenced our most important philosophy when it comes to helping others through scientific innovation. We made significant contributions to the development and production of phosphors for the revolutionary H2S radar screens, which were critical to the defence of Great Britain during World War II, and we have strived to make a positive impact ever since.

Applied Scintillation Technologies corporate name changed to Scintacor in 2015. We are known for being at the forefront of phosphor and scintillation technology, manufacturing products that allow the conversion of many different radiations into light for imaging and detection.

These products can be used in applications as diverse as medical and dental X-ray imaging, industrial quality control, neutron detection, oil well logging, mail, baggage and cargo inspection, analytical instrumentation, and radiation protection. The impact of the company’s products can be felt from the deepest recesses of the earth to as far away as Mars and Mercury.

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