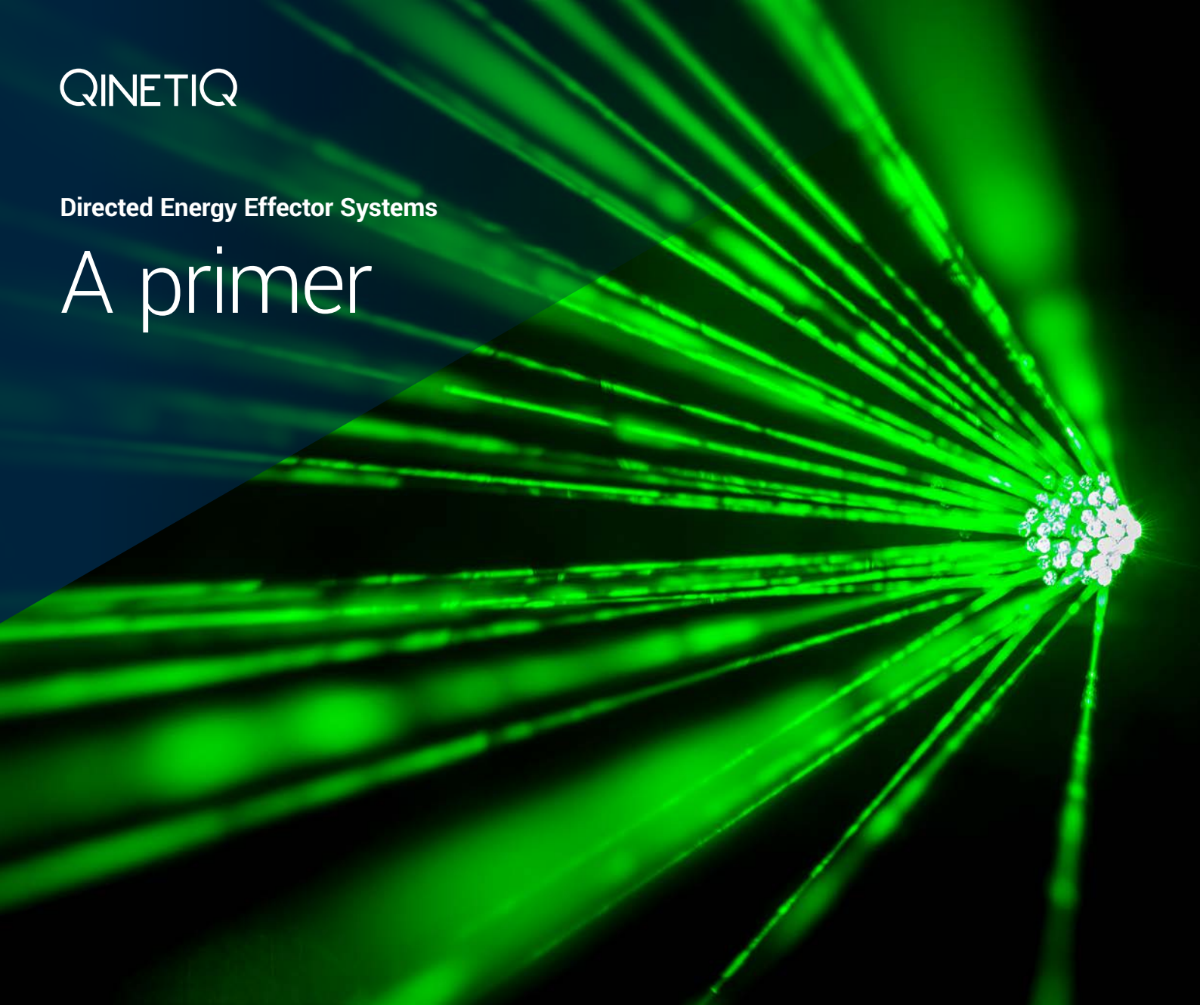
QINETIQ

Directed Energy Effector Systems

A primer



HEL and HPRF Effectors and effects have different military utility

Over the last 20 years interest and budgets for Directed Energy (DE) has wavered between prioritising High Energy Lasers (HEL) to prioritising High Power Radio Frequency (HPRF) DE. Indeed in 2010 MOD Science & Technology investment in HEL was almost completely withdrawn. However, both technologies have commonalities as described previously and particular differences which make them suitable for different challenging problem sets.

HEL Effectors – A primer

HEL Effectors produce a narrow beam of intense light, typically a few centimetres in diameter at the target. The strength or effectiveness of a Laser Directed Energy Weapon (LDEW) is often stated in Kilo Watts (kW). This is the power of the laser light produced at the laser source but it is not the only parameter that is important.

The light is often in the Infra-Red spectrum and not directly visible to the naked eye. When the light hits a target such as a UAV skin it is intense enough to burn the material of the target; maintaining the beam on the target for a few seconds leads to structural compromise of the target. Damage to target platform materials can be achieved in the order of ten Kilometres, with the present generation of HEL technologies.

HEL effectors can also dazzle and damage optical sensors on targets. Dazzle can be achieved at several tens of kilometres; sensors can be damaged at a few tens of kilometres.

HEL effectors are considered to be applicable to a variety of different military use cases such as:

- Missile defence, particularly defeat of anti-ship cruise missiles;
- Defending against Fast Attack Craft providing an intermediate force option where the use of lethal force may be questionable;
- Countering Surveillance assets such as UAVs by defeating optical sensors at range or by destroying the UAV platform;
- Defending against rockets, artillery and mortars by destroying them in flight.

However, the reality is that the HEL beam is affected by the atmospheric conditions between the HEL effector and the target. High precision tracking is needed to maintain the beam on the target for a few seconds and these factors make it difficult for a single HEL effector to engage multiple targets such as swarms of Unmanned Aerial Vehicles (UAVs).

HPRF Effectors – A primer

HPRF DE is different to HEL DE, the beams of radiated electromagnetic waves are wider and diverge. The divergence depends on the wavelength and the antenna aperture so the spot size on a target can vary from less than a metre to a few hundred metres.

Arguably the biggest advantage of HPRF is that it disrupts the computer brain inside of a target, rendering a functional kill of the target and the dwell time to achieve this may be much less than a second. Due to the wider beam width and because UAVs need their computer brains to stay aloft, HPRF effectors have utility against UAV swarm attacks.

HPRF can also jam wireless communications and data transfer between target assets, neutralising for example the command and control signals between a ground station and a UAV or between a missile and the aircraft that launched it. RF data and communications can be jammed at a few kilometres range.

In reality, largely because of divergence, HPRF effectors cannot achieve the same range as HEL effectors, perhaps limited to a few kilometres for functional kill effects. However, there is the possibility to manoeuvre or deliver the HPRF effector closer to the target. Functional kill effects are also innately variable.

Both technologies have commonalities and differences which is why Science & Techonology investment must address both so that the next 'big threat' is manageable.

Directed Energy Capabilities

It's not only about the effector source technology...

Importantly both technologies need to be considered in a systems-of-systems context. High precision sensors for target acquisition, tracking and aim-point maintenance; high precision steering and pointing mechanisms and richer command and control that may need to include automation are needed to get the best out of the effector.

Some of these technologies are already being developed by QinetiQ and our partners.

The U.S. Navy Afloat Forward Staging Base (Interim) USS Ponce (ASB(I)-15) conducts an operational demonstration of the Office of Naval Research (ONR)-sponsored Laser Weapon System (LaWS) while deployed to the Arabian Gulf.

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