

# Silent Launch

New directed-energy weapon balances strength, low cost and portability

DAVID A. FULGHUM/WASHINGTON

Urban warfare is going to take a new twist with the introduction of portable, directed-energy weapons into the confined battlefields that are expected to dominate early 21st-century combat.

Raytheon has built the first of its "Silent Guardian" millimeter-wave devices—which projects a 45-in.-dia., 30-kw. beam for an effective range of greater than 250 meters (820 ft.), says Mike Booen, vice president for advanced missile defense and directed-energy weapons. The device is wrapped around a large, gyrotron oscillator tube that generates the millimeter-wave beam, powered by an auxiliary 200-kw. generator and sized, so far, to fit on the bed of a Ford F550 medium-duty truck.

Building on work with larger and smaller experimental systems developed for the Air Force and the Pentagon's Joint Non-Lethal Weapons Directorate and Office of Force Transformation, Raytheon designers think they have found the sweet spot in balancing low cost with mobility, smaller size and effective weapons range.

The weapon operates at a frequency of 94 GHz, which makes it operational in rain, fog and smoke at roughly about the same distance a person can see in the same environment. Booen contends that's not a handicap given that rules of engagement would prohibit firing at unidentified targets. Raytheon officials say cost of the system is less than \$10 million, the result of an effort to drive the cost of directed-energy weapons down.

**EMBEDDED INTO SILENT** Guardian's antenna (which projects the beam) are visual and infrared sensors that monitor targets, Booen says. Since the effect of the weapon is to heat water in the outer 1/64th in. of the skin to the point of pain, the sensors are sensitive enough to detect the increased temperatures. As a result, operators can identify who is being affected by the beam. They can then shift aim to particular targets such as snipers in a given window or people carrying weapons in a crowd. The pain effect is immediate and aim can be adjusted in less than a second with a joystick control, he says.



Silent Guardian is one of the first directed-energy weapons ready for deployment. Its millimeter-wave-beam heats water in the skin to the point of pain.

The actual joule heating number used by the weapon is classified, but Raytheon researchers say the U.S. Air Force has established safety limits that the design has met. The beam goes through clothes and glass, but not wood or metal, Booen says. However, actual tests show that the beams penetrate even minute openings or cracks, for example, and sometimes appear almost to wrap around corners to affect fingers and feet of those trying to hide behind or hold up protective devices.

"The radio frequency is hard to block," Booen says. "Some of the people tested against tried to hide by laying down behind some concrete traffic barriers and the beam went underneath [where there was uneven contact with the ground]."

Silent Guardian will be one of the first directed-energy weapons actually ready for operational use and deployment, Booen says. It is ready for operational use about five years earlier than solid-state lasers, he contends. Silent Guardian follows Raytheon's Vigilant Eagle system that uses high-power microwaves produced by a billboard-size antenna to disable or misdirect shoulder-fired surface-to-air missiles at ranges of up to an estimated 100 km. (62 mi.). Company officials envision both Silent Guardian and Vigilant Eagle being used in an integrated, sensor grid as part of mobile, expe-

ditionary defenses for airfields or ports.

In the near term, however, Raytheon is demonstrating the concept to military, homeland defense and border patrol organizations that want a non-lethal defense option. Possible missions include riot control, embassy protection in foreign countries, perimeter security, clearing of roads and possibly ship defense. In cost and operational range, Silent Guardian also fits between the Air Force's larger, experimental 100-kw. Active Denial System (which was portrayed in Air Force presentations mounted in a C-130 cargo aircraft) and a smaller 400-watt, tripod-mounted system that worked at short ranges.

**BOOEN SAYS RAYTHEON** has been working with Air Force Research Laboratory for a decade on the technology which is now being introduced as part of a family of directed-energy weapons. Two smaller systems have been delivered to Sandia National Laboratory, N.M., and the Pentagon's Office of Force Transformation for testing. Part of the long-term plan is to produce a hand-held device in the next few years, if development money can be found.

While the weapon is functioning today, setting up a production line would take about eight months. Raytheon does not yet know if the technology can be exported.