

# JTLS-2014-12336 Laser Weapon System

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## 1.0 Summary of Model Change Request

Laser Weapon Systems (LWS) for ground, naval and aircraft are progressing through development, test and deployment within the US military and other major powers world-wide. Laser or energy beam systems use unique technology, but produce weapons effects similar to a kinetic mass munition. The LWS is distinctive in that it has no constraints on munition flight and is not easily represented by the concept of consumption, weight, and resupply as is normally done with physical weapons.

The purpose of this ECP is to properly represent LWS within the JTLS environment.

## 2.0 Design Summary

JTLS already models a laser weapon capability firing from an aircraft at a Theater Ballistic Missile (TBM). This means that a database builder can already build any laser weapon desired using the existing Targetable Weapon (TW) representation. As such it can be fired from a Surface-to-Surface Missile site or from an Air Mission at either an air target or a surface target.

A naval prototype of a LWS has already been fielded and deployed. This naval LWS is currently used against low-end asymmetric threats, such as drones and small boats, and thus may fire on either air or surface target. The ability for a single weapon system or target to fire both on an air target and a surface target is currently not a capability within JTLS. A major portion of this design concentrates on building this dual weapon system capability into the modeling environment.

The Design Team considered whether to allow:

- A Surface-to-Surface Missile target to also fire on air target, or
- An Air Defense Site target to also fire on a surface target.

The decision is to allow an Air Defense Target to fire as a Surface-to-Surface Missile site if the data indicates that the system can be used in this dual-purpose mode. This new capability does not simply apply to LWS; instead, it can also be used to more properly represent other current and future real-world weapons systems. For example, the ground based Close In Weapons System - Rocket, Artillery, Mortar (CIWS C-RAM) performs in both Surface-Surface and Surface-Air environment and thus will be properly modeled as a result of this design,

The Design Team looked into the representation of laser counter measures and concluded that no additional requirements need to be represented.

Non-lethal aspects of LWS, such as blinding or disrupting effects are also not considered as part of this design. These type of effects would need to be addressed in a separate ECP on Non-Lethal Weapon Effects. No such ECP is currently not scheduled for inclusion within the JTLS 5.1 release.

### 3.0 Detailed Design

Section 3.1 of this detailed design covers how JTLS will model the ability for a single Laser Weapon System (LWS) to fire at both air and surface targets. Section 3.2, Section 3.3, and Section 3.4 discusses why the design limits the representation of energy production, laser countermeasures, and non-lethal effects respectively.

#### 3.1 Laser Dual Use Representation

The primary challenge of the design is to allow air defense Surface-to-Air and Anti-Aircraft Artillery (SAM/AAA) targets to fire against their typical air targets as well as surface targets. This is a primary capability of existing naval LWS and other close in weapon systems (CIWS) currently fielded by the U.S. military.

Every Targetable Weapon (TW) in JTLS has three lethality attributes as summarized in Table 1.

Table 1. Targetable Weapon Lethality

LETHALITY DATA	MEANING
TW AIR AIR LETHALITY (AAL)	If a targetable weapon has this attribute specified, it can be fired from the aircraft on which it is loaded against another aircraft.
TW SURFACE AIR LETHALITY (SAL)	If a targetable weapon has this attribute specified, it is a feasible weapon associated with an Air Defense target. It cannot be placed on an aircraft and it cannot be fired from a Surface-to-Surface Missile (SSM) target.
TW SURFACE KILL LETHALITY (SKL)	If a targetable weapon has this attribute specifeid, it can be fired from an aircraft against a ground target or it can be fired from an SSM target.

JTLS allows a single Targetable Weapon to have some mixture of these lethality attributes. As a result of this design, there will be no limitations placed on specifying this lethality data. This concept is summarized in Table 2. The cells in green are a current combination capability within JTLS and the yellow cells indicate the combination capabilities that will be possible as a result of this design.

Table 2. Possible Lethality Combinations

MEANING	AAL	SAL	SKL
Weapon can be fired from an aircraft against an air target.			
Weapon can be fired from a SAM/AAA target against an air target.			
Weapon can be: <ul style="list-style-type: none"> <li>Fired from an SSM target using a FIRE MISSILE Order.</li> <li>Fired from an indirect fire Combat System using the FIRE ARTILLERY Order.</li> <li>Loaded on an aircraft and fired against a surface target.</li> </ul>			
Weapon can be: <ul style="list-style-type: none"> <li>Fired from an SSM target using a FIRE MISSILE Order.</li> <li>Fired from an indirect fire Combat System using the FIRE ARTILLERY Order.</li> <li>Loaded on an aircraft and fired against an air target or a surface target</li> </ul>			
Allows the TW to be loaded on an aircraft and fired against an air target. The same TW can be used by a SAM/AAA target against an air target. From this design's point of view, the same laser weapon can be placed on-board an aircraft or operated from a ground SAM/AAA target.			
Weapon, including laser weapons, can be: <ul style="list-style-type: none"> <li>Fired from an SSM target using a FIRE MISSILE Order.</li> <li>Fired from an indirect fire Combat System using the FIRE ARTILLERY Order.</li> <li>Fired from a SAM/AAA target at either an enemy air mission or an enemy surface target.</li> <li>Loaded on an aircraft and fired against a surface target.</li> </ul>			
Weapon, including laser weapons, can be: <ul style="list-style-type: none"> <li>Fired from an SSM target using a FIRE MISSILE Order.</li> <li>Fired from an indirect fire Combat System using the FIRE ARTILLERY Order.</li> <li>Fired from a SAM/AAA target at either an enemy air mission or an enemy surface target.</li> <li>Loaded on an aircraft and fired against an air target or a surface target.</li> </ul>			

Note that the lethality settings and combinations outlined in Table 2 does not imply that the weapon can be fired from any system Just because a given TW has an SKL specified does not mean that it can fire from any SSM target. The SSM sub-type indicates which TWs can be fired from that specific type of SSM. The same is true for Surface-to-Air weapon systems.

The data conversion process will not change the settings of these three lethality parameters for a given TW. It is up to the database builder to review their currently represented Targetable Weapons to determine if one or more of the TW can be combined into a single munition.

A SAM/AAA target is characterized by the attributes shown in [Table 3](#).

Table 3. Air Defense Class Attribute Summary

ATTRIBUTE	MEANING WHEN USED AGAINST	
	NORMAL AIR TARGET	NEW SURFACE TARGET
AD TARGETABLE WEAPON	Preferred weapon when firing on aircraft. If only weapon available, it will fire on a missile if there is some probability of killing the missile.	If the Targetable Weapon has a Surface Kill Lethality (SKL) specified, the target can fire on a surface target, either in response to a Fire Missile order (See <a href="#">Section 3.1.1</a> ) or the naval automatic engagement process (See <a href="#">Section 3.1.2</a> ).
AD ADVANCED TARGETABLE WEAPON	Preferred weapon when firing on a missile. If only weapon available, it will fire on an aircraft if there is some probability of killing the aircraft.	
AD AZ RANGE	The range at which this target can fire on an air object when the air object is in the specified Altitude Zone.	This database parameter will not be accessed by the model when using an Air Defense target is firing on a surface object.
TG RANGE	<p>The range at which this specific Air Defense target is allowed to fire. The target will not be allowed to fire on an air target that is further way than this database parameter. Two possible reasons for setting this parameter to a value smaller than the engineering capability of the Air Defense type are:</p> <ul style="list-style-type: none"> <li>• Represent a longer range Air Defense target being placed on the terrain in such a way that it cannot fire to its maximum engineering capability.</li> <li>• Represent a reduced capability to the system because of maintenance issues.</li> </ul>	This database parameter will be access by the model. The TG RANGE limitation will be applied to firing against surface targets as well as air targets. As described in <a href="#">Section 3.1.1</a> , the range will also be limited by the database parameter TW RANGE.

### 3.1.1 Fire Missile Order Logic

The Fire Missile Order has two primary methods

### 3.1.2 Automatic Firing Logic

## 3.2 Energy Production For Laser Weapon System

## 3.3 Laser Weapon System Countermeasures

## 3.4 Non-Lethal Effects Of Laser Weapon Systems

The JTLS Design Team considers the LWS naval weapon as simply a new type of LWS targetable weapon (TW) for use by an enhanced Air Defense (AD) target. Existing JTLS data structures in TWs, Targets and Lethality Tables will realistically model LWS in the operational environment. The design accommodates future upgrades to real world LWS, such as power output and ground or air use, with only database changes. Currently JTLS can represent the LWS behavior in the single domain (Surface, Surface-Air, Air-Air) with appropriate Targetable Weapon (TW) parameters. The USAF Airborne Laser 747 Aircraft has already been represented in JTLS to destroy a Theater Ballistic Missile or disrupt the arrival location.

This design specifically adds a dual Surface-Air/Surface-Surface capability to AD Targets. Any AD target will gain the ability to engage surface objects with a Surface - Surface Missile (SSM) TW if the TW references both Surface Kill Lethality and Surface-Air Lethality.

The design has two components:

- Modify Air Defense Class Target data structures to allow dual Surface Kill/Surface-Air Lethality capability.
- Create a dual Surface-to-Surface/Surface-to-Air capable TW Missile with LWS characteristics.

This design represents the LWS as a TW SSM assigned to an AD target. AD targets will gain new Surface-to-Surface capabilities using the order FIRE MISSILE. A similar approach of upgrading a Surface-to-Surface Missile (SSM) target to operate in the Surface-Air domain was considered and rejected by the Design Team.

## 3.5 Dual Lethality AD Target Capability

## 3.6 Dual Surface-to-Surface/Surface-to-Air Targetable Weapon

The dual Surface-Surface and Surface-Air Missile TW assigned to an AD target has design features that need clarification, but no departure from current JTLS Design is required. No modification to TW data structures is necessary for the design, except for the removal of a redundant attribute.

**Table 4. TW Entity Design Notes**

FEATURE	DEVELOPER NOTES
TW IMPACT TYPE	Attribute removed. The information will be derived from how the TW is used. Remove from all documentation.
TW SUPPLY CATEGORY	Mandatory, consistent with current JTLS design for TW. All TWs must draw from a Supply Category - no weapon has unlimited resources. The LWS does not consume supplies explicitly, but the Design Team recommends specifying a TYPE III fuel. This will represent a weapon with small but non-zero amount of consumption.
TW AIR AIR LETHALITY	Required for assignment to any AD target, consistent with current JTLS design.
TW SURFACE KILL LETHALITY	Required for dual capability. Current JTLS design SVP checks this when TW MISSILE CAPABLE is YES. Update DRM documentation to include "Dual Capable AD"
TW GUIDANCE TYPE	Current enumerations: ARM (Radar) or NONE. Add LASER enumeration to support ECP 2013-11441 Missile Guidance Systems.
TW WEIGHT	0.00001 or greater, consistent with current JTLS design. A real world LWS shot has no weight. A very small but non-zero weight will be mandatory consistent with all other TWs.
TW NUMBER MUNITIONS	Greater than or equal to 1. Consistent with current JTLS design. Required for Damage Calculations
TW NUMBER ROUNDS	Greater than or equal to 1. Consistent with current JTLS requirements. Required for Damage Calculations.
TW MISSILE CAPABLE	YES similar to a SSM fired from a SSM target. Update DRM Documentation to: "YES for either SSM target or Dual Capable AD Target"
TW SEARCH RADIUS	0.0, consistent with current JTLS design. The LWS is a light beam. The desired point of impact must be exactly where it is perceived to be.
TW RANGE	This attribute will apply only to the surface range capability of LWS
TW AUTO FIRE OK	YES, related to TW MISSILE CAPABLE and consistent with JTLS design. This is appropriate for LWS.
CS TW CAN FIRE	NO, consistent with current JTLS designs for missiles
TW CA CAN FIRE	NO, consistent with current JTLS designs for missiles

### 3.7 SVP Checks

**Table 5.**

<b>SVP CHECK</b>	<b>DESCRIPTION</b>	<b>CHANGE</b>
Error 328	The advanced TW for AD Target has no Surface-Air Lethality	Add: The TW may have an optional Surface Kill Lethality
Error 329, 330, 331	Lethality Table for TW does not match TW TYPE IMPACT	Remove: Reference to TW TYPE IMPACT. These errors may be removed.

## 4.0 Data Changes

The following attributes will be removed from the TARGETABLE WEAPON Entity.

### TW IMPACT TYPE

- Current enumerations: AIR TO AIR, SURFACE TO AIR, AIR BURST, SURFACE BURST, or SUBSURFACE BURST
- This information will be derived from the method the TW is employed. TW IMPACT TYPE will be redundant.

## 5.0 Order Changes

The FIRE MISSILE Order will be used to represent firing the LWS in a Surface-Surface mode from AD Targets. This order requires no changes to its WHIP display. The underlying code must consider Dual Capable AD targets in addition to SSM targets when creating Fire Missions. No order parameter or structure changes are required to implement this design.

## 6.0 JODA Changes

No JODA Data System parameter, structure, or protocol changes are required to implement this design.

## 7.0 Test Plan

Text *[Describe the basic test objectives and procedures. This Test Plan section may be published as a separate document.]*

### 7.1 Test 1 Title

Purpose: *[Describe the specific feature, function, or behavior to be tested or measured.]*

Step 1: Text

Step 2: Text

Expected Results: *[Describe the specific model behavior to be observed.]*

### 7.2 Test 2 Title

Purpose: Text

Step 1: Text

Step 2: Text

Step 3: Text

Expected Results: Text