MISSION 8 ARENA LOGISTICS

Before referring to this document, one should first read the Official Rules for the Mission 8 concept. The Official Rules explain the mission and its components. This Arena Logistics document is intended to show how those components will be implemented.

COMPONENTS OF THE ARENA
The Mission 8 scenario depends upon several arena components. These are:

1. The Arena space.
2. Arena obstacles/cover
3. Locked bins
4. The "Critical Component"
5. Sentry Aerial Robots.
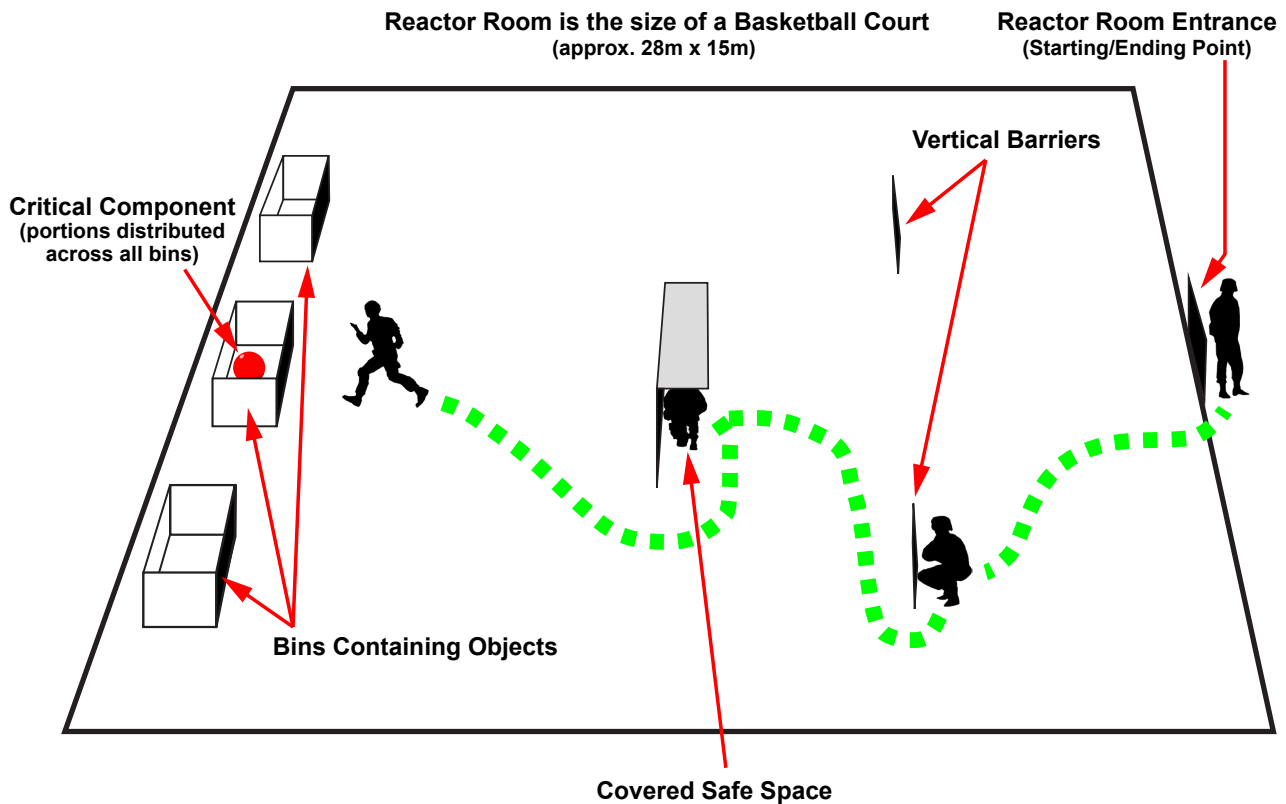6. The helmet
7. Judges and Arena Support staff members

The various competing teams will supply one person (the "player") and one to four fully autonomous aerial robots that can take cues from the player to assist him in achieving mission goals. The Official Rules describe what the teams need to develop to achieve those mission goals.

THE ARENA AND ARENA OBSTACLES
The arena is sized so that Mission 8 can be performed on a standard basketball court that is approximately 28m x 15m. This arena simulates a "reactor room" with a single entrance at one end. The 28m x 15m boundary line will be indicated by a white tape line surrounding the area of "gameplay". No specific detail about this boundary line has been specified in the Official Rules. Teams will only know that there is a boundary within which they should confine their activity. In fact, most arena details have been left intentionally vague so that teams are not encouraged to design their Mission 8 solutions around arena specifics.

The arena will have a "reactor room entrance" which will be a stationary barrier the size of a single door that the player stands behind prior to the beginning of the run. The player then steps around the barrier to enter the arena.

Within the arena will be two barriers placed 25% of the way from the "reactor room entrance" and 25% from either side of the arena. There will be a barrier centered on the arena. This barrier will also have a 0.75m flat roof. At the far end of the arena will be four (4) "bins" one meter from the opposite side of the arena from the "reactor room entrance".

Reactor Room is the size of a Basketball Court (approx. 28m x 15m)

Reactor Room Entrance (Starting/Ending Point)

Vertical Barriers

Critical Component (portions distributed across all bins)

Bins Containing Objects

Covered Safe Space

THE BINS

There are four (4) bins placed one meter from the boundary opposite the "reactor room entrance" side. These bins are large boxes with hinged top lids that can be locked with a simple four-digit hasp lock. Each bin has a handle on the lid near the hasp lock to allow the lid to be easily opened. The bins are painted black and identical in appearance except for a 0.3m tall ARIAL BOLD white character centered on the bin. When viewed from the "reactor room entrance", the left bin will have an "**I**", the next bin will have an "**A**", the next bin will have an "**R**", and the right bin will have a "**C**" (spelling "**IARC**").

Each bin will have a four-digit hasp lock preventing the bin from being opened unless the correct combination is entered onto the lock. On the lid of each bin will be a four-digit display that is driven from a common micro computer that is wired to each of the bins. The micro computer will display part of the code necessary to open one of the locks on one of the bins. These four-digit displays must be viewed simultaneously to decipher the lock code. In addition, the lock code segments will change in unison periodically to prevent the code from being deciphered by looking at the displays serially-- they must be viewed simultaneously (something that the human player can not do without the assistance from his "helper aerial robots".

Details

- 4 Bins, each with a combination lock.
- Each bin also has a 7-segment display.
- Each display has a defect.
- Taken together simultaneously, the correct code can be seen. The code must be entered into each lock to access the four parts comprising the "critical component".
- There are 4 bins, and up to 4 helper robots.
- The bad segments on the displays rotate every 60 seconds (the code remains the same, but the displays changes, so the correct code must be determined within 60 seconds or the entire recognition must start over. This prevents one helper robot from going from one display to the next while remembering what it saw.
  All four need to fuse data simultaneously, or a single robot could remember previous pictures over a 4 minute period.
- Time is spent manipulating combinations during which the hostile sentries have a relatively stationary target to hit.
- Teams will need 4 helper aerial robots to efficiently execute this part of the mission.
- Judges will have a multiple locks, 4 of which are identically coded and used at any time. There are 4 displays (one on each bin) that are programmed to show the same number (lock combination) AND are programmed to have one of 4 failure modes (MIDDLE ROW BAD, RIGHT COLUMN BAD, etc.). These failure modes rotate among the displays every 60 seconds.

(LEFT COLUMNS BAD)

(RIGHT COLUMNS BAD)

(COMPOSITE)

BIN LOCK #2

(MIDDLE ROW BAD)

(BOTTOM & TOP ROW BAD)
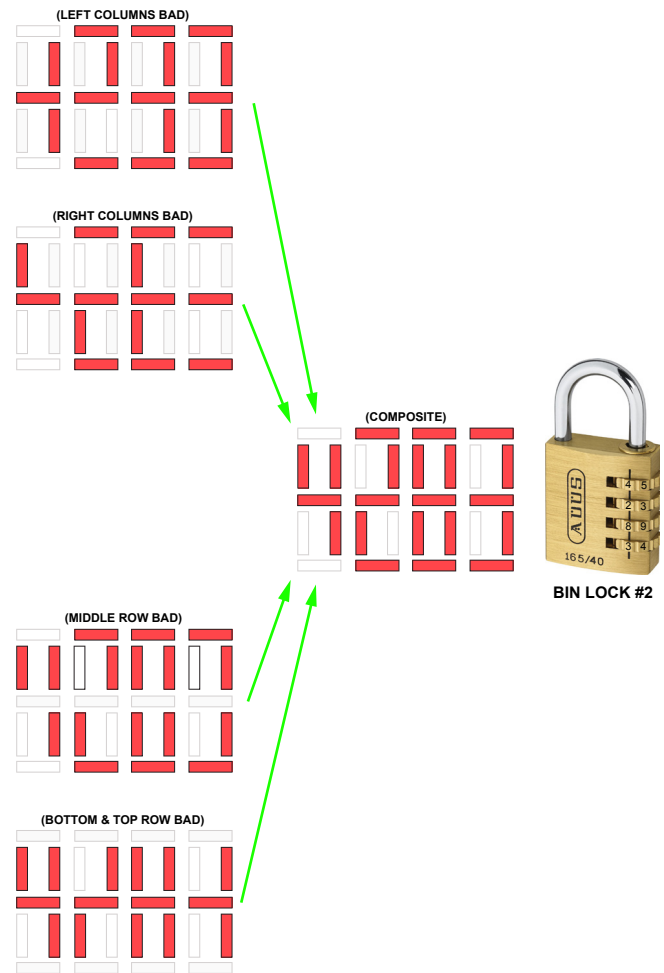
CRITICAL COMPONENT

Each of the bins will contain various random objects. Random objects are things the size of a football (soccer ball). Other items might be empty cardboard boxes, stuffed toy animals, or similar non-technical items. The purpose of these non-technical items is to obscure and delay the player from acquiring the sections of the "critical component" immediately upon opening a bin, thereby increasing the likelihood that a Sentry aerial robot can successfully attack the player. The "critical component" will be a technical item that looks like something which might be used to repair a reactor. This item will be identical for both venues. The "critical component" will be distributed across the four bins as component parts that plug together to create the "critical component".

CRITICAL REACTOR COMPONENTS

SENTRY AERIAL ROBOTS

There will be four (4) Sentry aerial robots in play at all times. If a Sentry is disabled or fails due to inadequate battery state-of-charge, Arena Staff Members will immediately launch a new Sentry aerial robot into the arena to maintain four operational sentries at all times.

Sentry aerial robots will have the ability to detect and follow the player with the orange helmet (described below). Sentries will also carry visual laser illuminators, not unlike "Laser Tag" transmitters, which when in range of the orange helmet worn by the team's player, will score "hits" that will subtract from his maximum number of "lives". Once the player has been hit the requisite number of times, he is "dead" and the run is concluded.

The Sentry aerial robots will behave similar to the Hover Camera or DJI Spark drones in terms of acquiring, following, and maintaining a certain stand-off distance from the or-ange helmet target. Each Sentry will have a continuously-running laser illuminator that is coded as a Sentry "hit" signal. To simplify vertical targeting, these lasers will emit a vertical laser "sheet". The orange helmet will arbitrate hits and their timing, while keep-ing track of the number of valid hits.

Sentry robots can unintentionally collide with the teams' friendly Helper robots or arena obstacles, but the teams' friendly Helper robots can not collide with the Sentry robots, or else they will be grounded by an Arena staff member or Judge until the end of the run.

THE HELMET

The helmet is the most complex part of the arena. It provides an easily tracked unique item in the arena and is responsible for arbitrating hits and healings, counting hits, and determining when the player is dead.

Beyond the orange-colored helmet itself, there are laser sensors arranged around the helmet, a micro computer that interrogates those sensors and outputs values to a two-digit "hit display", and a battery to run the helmet systems.

The micro computer increments and decrements the two-digit display mounted on the front of the helmet. A beeper indicates new "hits". Healing hits from friendly Helper ae-rial robots are also recognized and result in the hit counter being decremented up to four times during the run. Once the number hits exceeds the maximum allowable, the beeper sounds continuously and the run terminates.

The logic for hit monitoring is as follows (10 hits = DEAD/end of run):

Initialize COUNT = 0 and HEALING = 0 on RESET

READ	**Write COUNT to display**	
	GOTO 5SECOND	**Prevents new hits from being detected for 5 seconds**
	Read Laser Sensors 1 - 8	
	IF No Signal then GOTO READ	
	ELSE IF Healing Signal Detected GOTO DECREMENT	
	ELSE IF Sentry Signal Detected GOTO INCREMENT	

DECREMENT	**IF COUNT = 0 then GOTO READ**	**Can not have negative hits**
	ELSE IF HEALING = 4 GOTO READ	**There can be only 4 healings**
	ELSE COUNT = COUNT - 1	**Healings decrement the hit counter**
	HEALING = HEALING + 1	**There can be only 4 Healings, so we count them**
	GOTO READ	

INCREMENT	**IF COUNT = 10 then GOTO BEEPERLOOP**	**Beep once when hit**
	ELSE COUNT = COUNT + 1	**Increment count when hit**
	GOTO READ	

1SECOND	**Loop for 1 Second**	**Delay for 1 second**
	Write COUNT to display while looping	
	RETURN	

5SECOND	**Loop for 5 seconds**	**Delay for 5 seconds**
	Write COUNT to display while looping	
	RETURN	

BEEPERLOOP	**Pulse Beeper**	**Endless loop - beep once per second until reset**
	GOTO 1SECOND	
	GOTO BEEPERLOOP	

JUDGES AND ARENA SUPPORT STAFF

There should be four (4) judges who know the Official Rules and who are knowledgeable about aerial robots, artificial intelligence, and electrical/mechanical/aerospace/computer engineering. The Judges are responsible for monitoring the timing of events, scoring performance, and assessing safety and qualifications. Judges will determine the code to be displayed on the bins, and the pre-coded locks to use on the bins containing the "critical component" without the knowledge of the next team to attempt a successful run. Judges will also determine the order performance and when a team pass is accepted, or when a team forfeits an attempt.

Arena Support Staff are responsible for setting up the arena, maintaining its configuration, and disabling team Helper aerial robots that collide with Sentry robots or which land in the arena. To prevent confusion, only one member of the support staff will be assigned
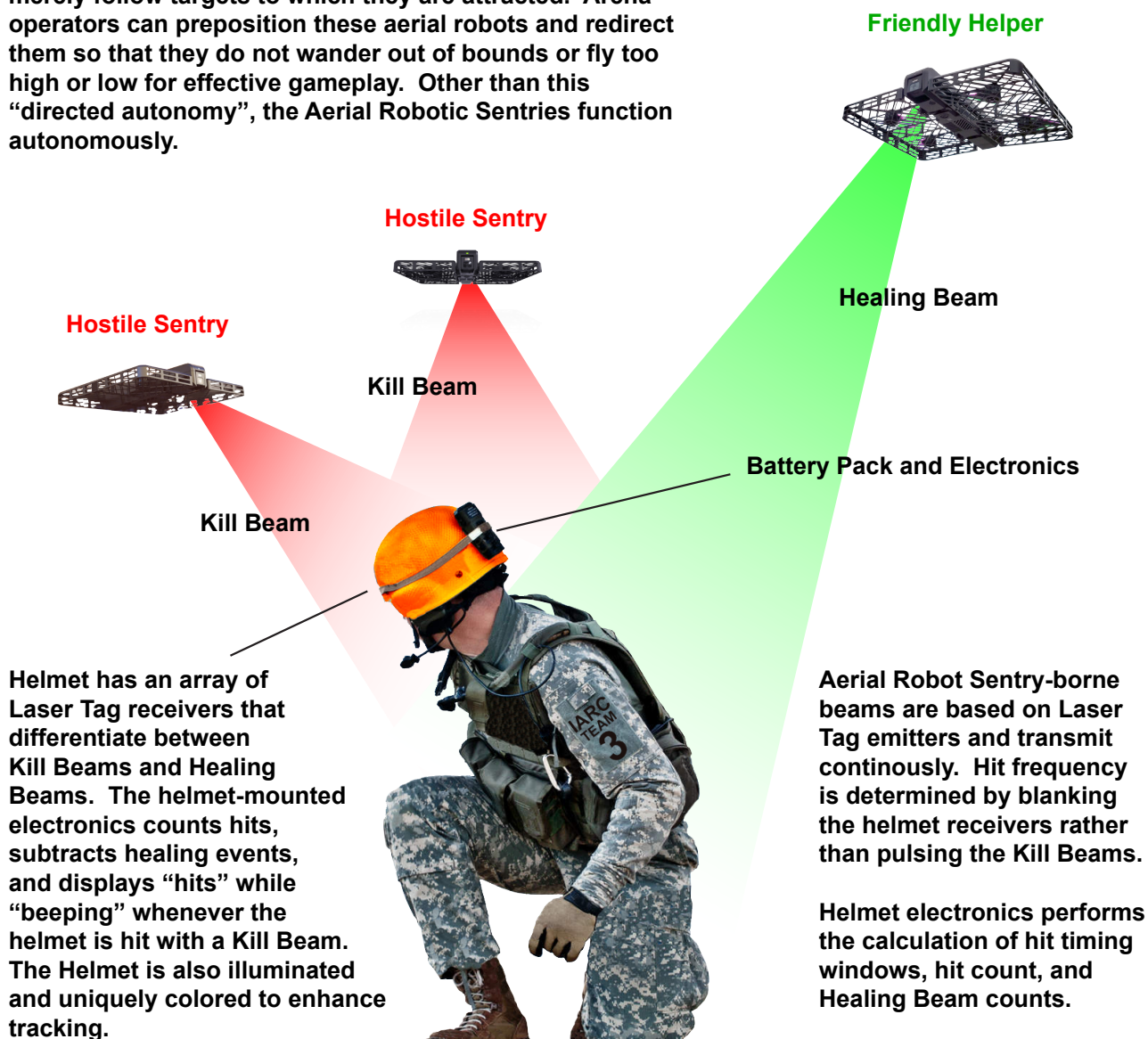
to control the disabling mechanism for a single team Helper robot. This means that there will be four Arena Support Staff members dedicated to watching and keeping track of each of the four team aerial robots (if up to four are used by a team).
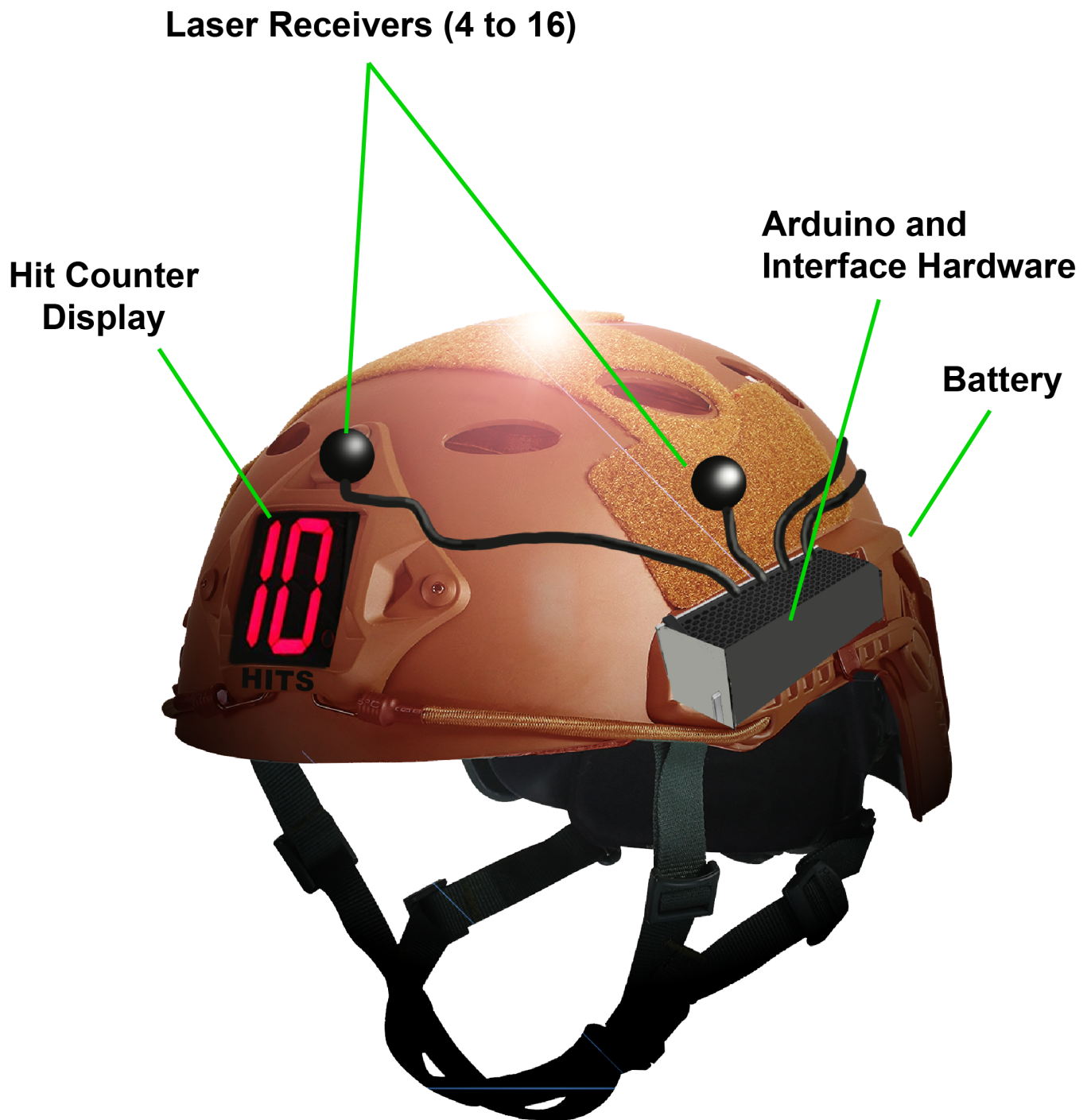
An attempt system similar to that used in Mission 7 is envisioned for Mission 8.

ARENA ASSETS

Aerial Robotic Sentries belong to the arena and will be replaced by arena operators to assure that four (4) are operational within the arena at all times.

Aerial Robotic Sentries fire Kill Beams continuously and merely follow targets to which they are attracted. Arena operators can preposition these aerial robots and redirect them so that they do not wander out of bounds or fly too high or low for effective gameplay. Other than this "directed autonomy", the Aerial Robotic Sentries function autonomously.

Friendly Helper

Hostile Sentry

Healing Beam

Hostile Sentry

Kill Beam

Kill Beam

Battery Pack and Electronics

Helmet has an array of Laser Tag receivers that differentiate between Kill Beams and Healing Beams. The helmet-mounted electronics counts hits, subtracts healing events, and displays "hits" while "beeping" whenever the helmet is hit with a Kill Beam. The Helmet is also illuminated and uniquely colored to enhance tracking.

Aerial Robot Sentry-borne beams are based on Laser Tag emitters and transmit continously. Hit frequency is determined by blanking the helmet receivers rather than pulsing the Kill Beams.

Helmet electronics performs the calculation of hit timing windows, hit count, and Healing Beam counts.

Laser Receivers (4 to 16)

Arduino and
Interface Hardware

Hit Counter
Display

Battery

10
HITS

Notional Helmet Configuration