LUNARO RATING SPECIFICATION

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1 Purpose

This document defines and standardises a community-made attempt at creating a ranking system for Lunaro[1], a Player versus Player (PvP) game mode in Digital Extreme's Warframe[2]. The system is based on Elo[3] and has been adapted for use in the unique circumstances Lunaro finds itself in.

2 Player ability

Using the current raw rank to calculate the new ranking post-match is not sufficient for Lunaro. Ranks must undergo a certain degree of pre-balancing into a more accurate representation of a player ability given the circumstances before new rankings can be applied.

2.1 Why rank does not equal ability

Unlike chess for example, Lunaro is a network-based game. This ultimately means that there are several factors which inhibit the purism of Elo itself. Specifically, these factors are network quality and network latency.

Through Warframe's user interface, we however only directly have access to one of these metrics: Network latency (hereafter referred to as "ping"). Why do we not have access to the other? Reading the Warframe's network metrics from memory at runtime is prohibited as per its EULA[4] §2 and §4. The prohibition is vague (as is common in legal texts), but risky to ignore.

While these two metrics could technically be monitored independently from the game, it would create an additional layer of complexity to the way a player's rank is calculated, as well as require each and every player to closely monitor these metrics. This is, as not all Lunaro players are as technologically savvy, not feasible to say the least.

[1] https://warframe.fandom.com/wiki/Lunaro
[2] https://www.warframe.com
[3] https://en.wikipedia.org/wiki/Elo_rating_system
[4] https://www.warframe.com/eula

Meanwihle, ping can be easily viewed via Warframe itself and its concept is commonly known to the largest portion of the playerbase. Thus, only ping is to be considered. This makes a compromise of a "nigh perfect" system for the sake of simplicity and the sanity of the curators.

2.2 Calculating ability

The player ability A is dependent on the player's rank $R \in \mathbb{N}_0$ and the player's ping $P \in \mathbb{N}_0$ (which is equal to 0 for the host of the match). The idea essentially is that a higher ping P in turn causes a lower ability A which is then used for calculating the new rankings R'. The calculation of A is non-linear and instead based on the hyperbolic secant, which is defined as follows for any number $n \in \mathbb{R}$:

$$\operatorname{sech}(n) = \frac{2}{e^n + e^{-n}} \tag{1}$$

To calculate A, one last parameter must be defined. This parameter is I, which describes what is known among curators as the "ping influence", controlling the steepness of the hyperbolic secant. The lower I, the steeper the function, resulting in a larger deduction for higher ping P. The curators have settled on the following:

$$I = 300 \tag{2}$$

The player ability A can then be calculated as follows:

$$A = R \cdot \operatorname{sech}(\frac{P}{I}) \tag{3}$$

3 Calculating new rankings

Now that A can be calculated for both players (a and b respectively), it is now possible to start calculating their new ranks R'. We begin by calculating the expected scores:

$$E_a = \frac{1}{1 + 10^{\frac{A_b - A_a}{400}}} \tag{4}$$

$$E_b = 1 - E_a \tag{5}$$

$G \in \mathbb{Z} : G \in \{0, ..., 22\}$ describes the amount of goal points each player scored during the Lunaro match. The sum $G_a + G_b \in \{0, ..., 41\}$ cannot exceed the final match result of 22 to 19, as the match would end prematurely if one player reached 20. Due to the game's "unstable Lunaro" mechanic however, the winning player may also finish the match with 21 or 22 points. We now calculate the score S which represents the distribution of G:

$$S_a = \frac{G_a}{G_a + G_b} \tag{6}$$

$$S_b = 1 - S_a \tag{7}$$

The penultimate step is defining the K-factor K. It describes the maxiumum possible adjustment per game, ergo it says how much a rank can rise or fall for $S \in \{-1, 1\}$. For Lunaro, these differ for different ranges R (not A) can be in:

- $R \in \{0, ..., 1499\} \therefore K = 40$
- $R \in \{1500, ..., 2499\} \therefore K = 20$
- $R \in \{2500, ..., n\} \therefore K = 10$

IMPORTANT: To increase the impact of the initial rankings however, the curators have temporatily unified the K-factor across all ranges:

$$K = 50 \tag{8}$$

Finally, we can put all of this math together to form one single calculation for R':

$$R' = R + K \cdot (S - E) \tag{9}$$

4 Attributions

The following people[5] have worked together to collaboratively curate the ranking system and create this specification:

quonnz	author, curator
koza1brada	curator
Yujas	architect, curator

[5] Warframe usernames listed