Erratum to "Anonymous Tracking using RFID tags" [INFOCOM 2007]

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Generally, the following accuracy metric is used for the counting estimators: probability that the estimation error is in a given interval, with a certain confidence; i.e., $P[\epsilon \leq \theta] \geq \alpha$, $\epsilon = \left|\frac{t-\hat{t}}{t}\right|$, where t is the true and $\hat{t}$ is the estimated number of tags, respectively.

The accuracy metric used in [1] is $Z_\alpha \sqrt{\delta_0} \leq \beta\, t$ (see [1], page 1222), where $Z_\alpha = \sqrt{2}\,\text{erf}^{-1}(2\alpha - 1)$ is the α-quantile of unit normal distribution, δ_0 is the estimation variance. In the following, we provide the corrected form of this relation.

The estimation $\hat{t}$ was shown to have a Gaussian distribution with mean t and variance δ_0. The left-hand-side of the accuracy relation can then be written as:

$$P[\epsilon \leq \beta/2] \;=\; P[(1-\beta/2)t \leq \hat{t} \leq (1+\beta/2)t] = \text{erf}\left(\frac{\beta t}{2\sqrt{2\delta_0}}\right). \quad (1)$$

The accuracy metric becomes:

$$P[\epsilon \leq \beta/2] = \text{erf}\left(\frac{\beta t}{2\sqrt{2\delta_0}}\right) \geq \alpha. \quad (2)$$

Rearranging the equation yields:

$$\text{erf}^{-1}(\alpha)\sqrt{2\delta_0} \leq \frac{\beta t}{2}, \tag{3}$$

$$Z_{\frac{1+\alpha}{2}}\sqrt{\delta_0} \leq \frac{\beta t}{2}. \tag{4}$$

Therefore, for $\alpha = 99\,\%$ the α-percentile $Z_{\frac{1+\alpha}{2}} = 2.576$ as opposed to the used $Z_\alpha = 2.33$ in the paper (see [1] page 1219).

In [1] page 1218, the confidence interval is defined to have a width of β, which is incorrect. The results described in the paper use a confidence interval of 2β. In other words, the problem solved is the following:

Given the responses $B_i, i = 1, 2, ..., M$, from M queries, we have to estimate the total number of tags in the system with a confidence interval of width 2β, i.e., we want to obtain an estimate $\hat{t}$ such that $\frac{\hat{t}}{t} \in (1-\beta, 1+\beta)$ with probability greater than α.

In order to reflect this erratum, on page 1222 of [1], the first paragraph should be amended as follows:

If we want the error of the estimate $|t - \hat{t}|$ to be within βt, we need...

The equations and results presented in the paper assume that the width of the confidence interval is 2β, as described above. The results will vary to account for the error in the α-percentile (i.e., for using Z_α instead of $Z_{\frac{1+\alpha}{2}}$).

The main implication of the erroneous relation is that the number of slots required for a given accuracy is *underestimated* in [1]; e.g., for the investigated cases in the paper the reported values are 17% less than the correct values (see Table 1 for the corrected results using the relation $Z_{\frac{1+\alpha}{2}}\sqrt{\delta_0} \leq \beta t$.).

Table 1: Slots required to estimate the neighbor cardinality of EZB [1]

α	β	range r	total slots reported in [1], Table IV	total slots (corrected)
$99\,\%$	0.05	0.1	7018	8470
$99\,\%$	0.05	0.01	14036	16940

References

[1] M. Kodialam, T. Nandgopal, and W. C. Lau. Anonymous tracking using RFID tags. In *Proc. IEEE Intern. Conf. on Comput. Commun. (INFOCOM)*, Anchorage, US-AK, May 2007.