Acknowledgements

Authors would like to thank reviewers for their valuable comments and suggestions.

Table 5: Embedding serial number with serial code

Rules to find a embedding position:
if n>tb then
if tb-pt =1 then
start embedding SCode with first position of the successive tag.
else:
start embedding the SCode in the position where position=pt
 	
Where , n= total set member, tb =total length of the tag serial and pt= present serial code embedded position

Serial number after performing operation in Eq. (1) is "$d_1e_1f_1g_1h_1i_1j_1$" and tb=7.

Table 5: Embedding serial number with serial code(continued)

d_1(First digit pt=1)	e_1(second digit pt=2)		i_1(second to last pt=6)	d_1(First byte pt=1)
Tag1's serial code will be xored with "d_1e_1".	Tag2's serial code will be xored with "e_1f_1".	....	Tag6's serial code will be xored with "i_1j_1". (tb-pt)=(7-6)=1	Tag7's serial code will be xored with "d_1e_1".

Table 6: Serial code generation and embedding process

Label	Values		
Sequence no.	Tag 1	Tag 2	Last tag of the set(Tag n)
Plain text serial in decimal	1234567_{10}	1234568_{10}	1297899_{10}
Calculation for tag serial generation	h(S_1 ⊕(EM⊕OC)) =h(12D687⊕(22EDFBB⊕3F6265)) =h(12D687⊕0211bdde) =h(02036b59) = $eb3ee97e_{16}$	$05ad40a6_{16}$	$d0449353_{16}$
Serial code generation	$1+2+6+7+8+9+9=45_{10}$=**2D**$_{16}$ = this is the SCode of tag n	$1+2+3+4+5+6+7=28_{10}$=**1C**$_{16}$ = this is the Scode of tag 1	**2C**$_{16}$ = this is the Scode of n-1 tag.
Processed serial for writing to a tag.	**c6**$3ee97e_{16}$	0**46**$d40a6_{16}$	etc

Table 9: Summary of comparative study

Protocols	Tamper evidence	Restoring tampered data	Linkability resistance for OM and OC	Technique/s used	Applicability with existing hardware	Robustness
Mohan et al. [11]	√	√	X	Stenography	√	Δ
Potdar et al. [12]	√	X	X	watermarking	Δ	Δ
Noman et al. [13]	√	X	X	Watermarking	√	√
Noman et al. [14]	√	X	X	Watermarking	Δ	Δ
Yamamoto et al. [15]	√	X	X	Write activity	X	X
Proposed protocol	√	√	√	Hybrid(Watermarking and stenography)	√	Δ

References

1. Gandino, F, Montrucchio, B & Rebaudengo, M (2010). 'Tampering in RFID: A Survey on Risks and Defenses', Mobile Networks and Applications, vol. 15, no. 4, pp. 502-16.
2. EPCglobal.http://www.epcglobalinc.org/standards/tds
3. Dennis M.-L. Wong and Raphael C.-W. Phan(2006). RFID systems: Applications versus security & privacy implications, IDEA group, 2006.
4. Dirk Henrici and Paul MÄuller, (2004). Hash-based enhancement of location privacy for radio-frequency identification devices using varying identifiers, IEEE International Workshop on Pervasive Com-puting and Communication Security- PerSec, pp.149-153.
5. Su-Mi Lee, Young Ju Hwang, Dong Hoon Lee, and Jong In Lim, (2005). Efficient authentication for low-cost RFID systems, International Conference on Com-putational Science and its Applications - ICCSA, pp. 619-627.
6. Ray, Chowdhury and Pham (2010). Mutual Authentication with Malware Protection for RFID System. Annual International Conference on Information Technology Security (ITS 2010). I-24 - I-29
7. J. Abawajy. (2009). Enhancing RFID Tag Resistance against Cloning Attack, 3rd International Conference on Network and System Security, pp.18-23.
8. Ari Juels, Ronald L. Rivest, and Michael Szydlo(2003). The blocker tag: Selective blocking of RFID tag for consumer privacy, 8th ACM conference of Computer and Communication Security, page 103-111
9. MF3ICD21, MF3ICD41, MF3ICD81 (2009) MIFARE DESFire EV1 contactless multi-application IC. Product short data sheet. Rev. 02
10. EPC radio-frequency identity protocols class-1 generation-2 UHF RFID protocol for communications at 860 MHz–960 MHz (2004)
11. Mohan, M., et al.(2006) Recovering and restoring tampered RFID data using steganographic principles. in Proceedings of the IEEE International Conference on Industrial Technology (ICIT06)
12. Vidyasagar Potdar, Elizabeth Chang(2006). "Tamper Detection in RFID tags using Fragile Watermarking," To Appear in the Proceedings of the IEEE International Conference on Industrial Technology (ICIT06), Mumbai, INDIA.
13. Noman, ANM, Curran, K & Lunney, T (2010). 'A Watermarking Based Tamper Detection Solution for RFID Tags', in Intelligent Information Hiding and Multimedia Signal Processing (IIH-MSP), 2010 Sixth International Conference on, pp. 98-101.
14. Noman, KCaTLaANM (2011). 'Tamper Detection for Low Cost RFID Tags: Using Watermarking with Chaotic Mapping', International Journal of Engineering and Technology, vol. Volume 1 no. No. 1, p. 6.
15. Yamamoto, A, Suzuki, S, Hada, H, Mitsugi, J, Teraoka, F & Nakamura, O (2008). 'A Tamper Detection Method for RFID Tag Data', in RFID, 2008 IEEE International Conference on, pp. 51-7.