

Poboljšanje performansi RFID sustava

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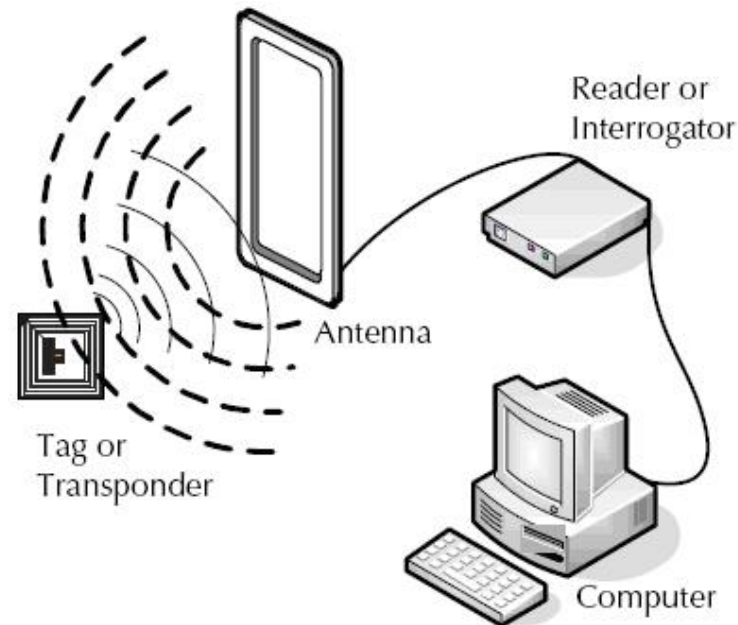


Sadržaj

- “ Uvod - RFID općenito
- “ Pasivna Gen2 Tehnologija - moderni bar kodovi
- “ Integracija HF/UHF tehnologija
- “ Broj pročitanih tagova u sekundi
- “ Zaključak



Uvod – RFID općenito



Slika: Komunikacijski model standardnog RFID sustava

Podjela I:

” LF (Low Frequency - 125 kHz)

” HF (High Frequency - 13.56 MHz)

” **UHF (Ultra High Frequency - 860-960 MHz), Gen2**

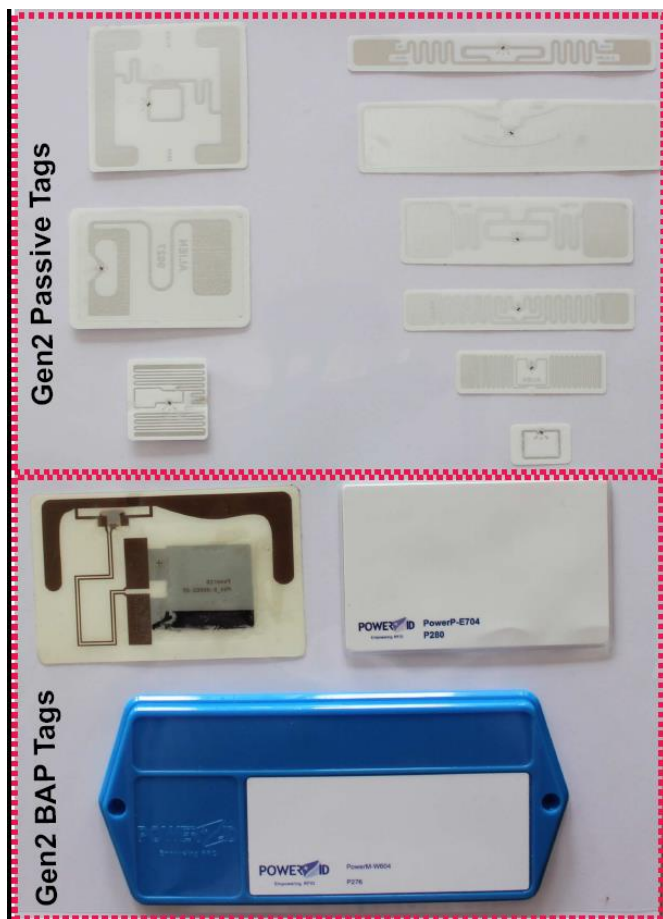


Uvod – RFID općenito

Podjela II:

” Pasivni

” Baterijski potpomognuti (BAP)

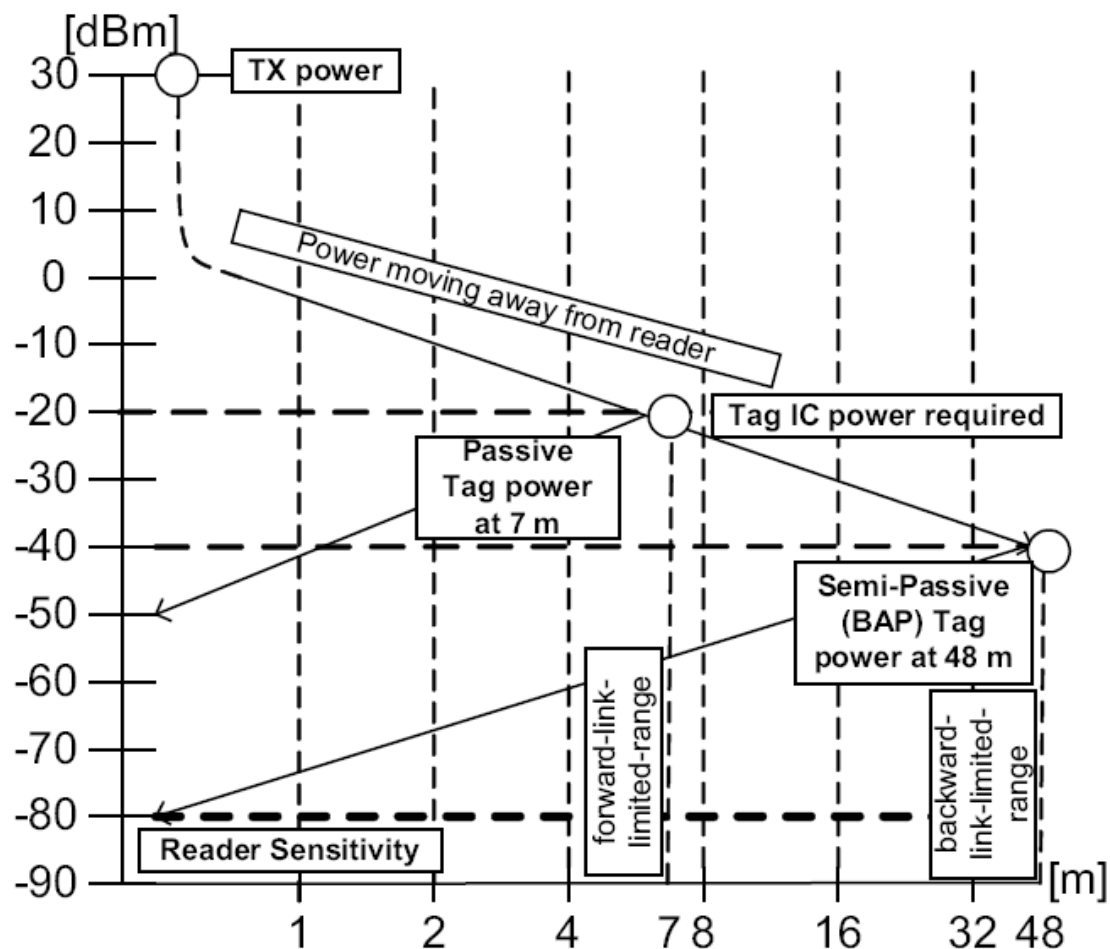


Slika: Različite vrste Gen2 tagova

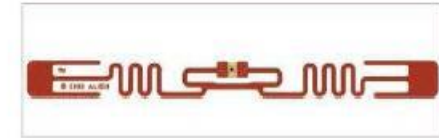
Domet: pasivni - 10ak m., BAP – 40ak m. (NLOS)

Potrošnja: 10 μ W

Memorija: programabilnih EPCglobal 96-bit



barcode vs. RFID

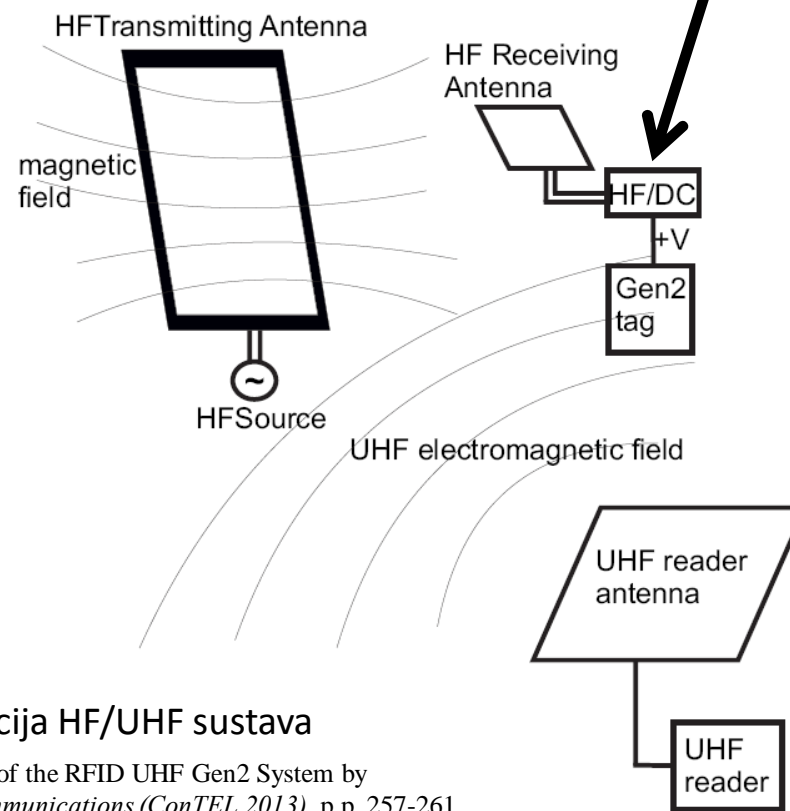
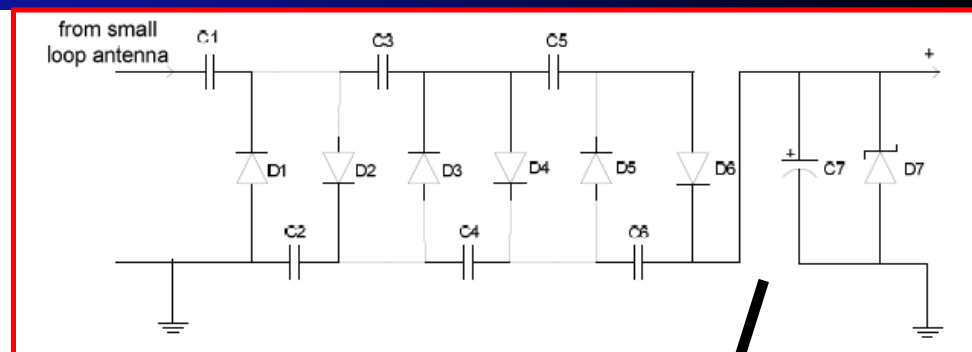
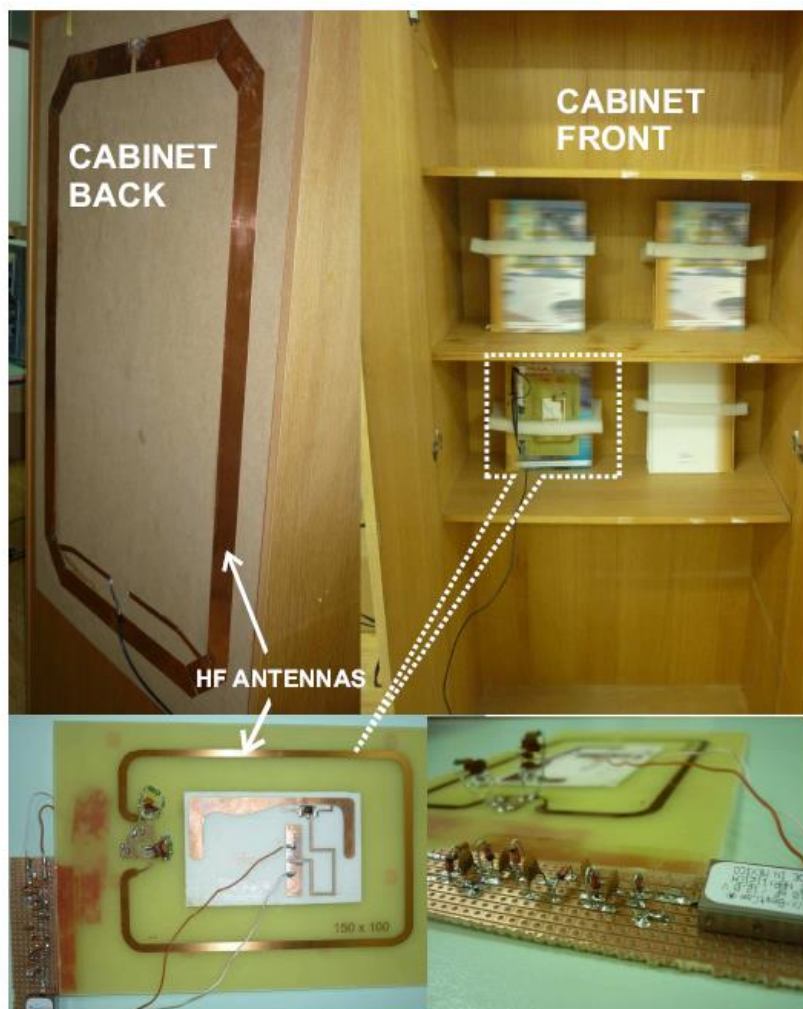


opis	barcode	RFID
potrebna optička vidljivost	da	ne
udaljenost za čitanje	neposredna blizina	10m
brzina čitanja	0.5s/bar kodu	≈40 tagova/s (tipično)
čitanje/pisanje	čitanje	čitanje/pisanje
cijena	0.005 USD	0.05 USD

Saying bar codes are cheaper than RFID tags is like saying a wood-handled hammer is cheaper than a nail gun., Mark Roberti, RFID Journal



HF/UHF integracija [1]

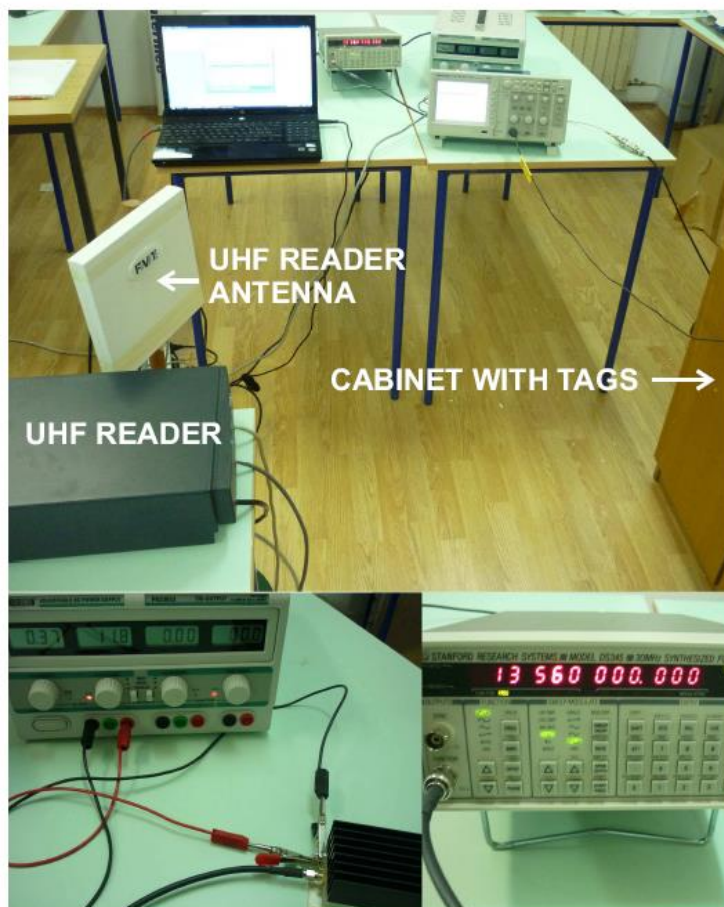


Slika: Integracija HF/UHF sustava

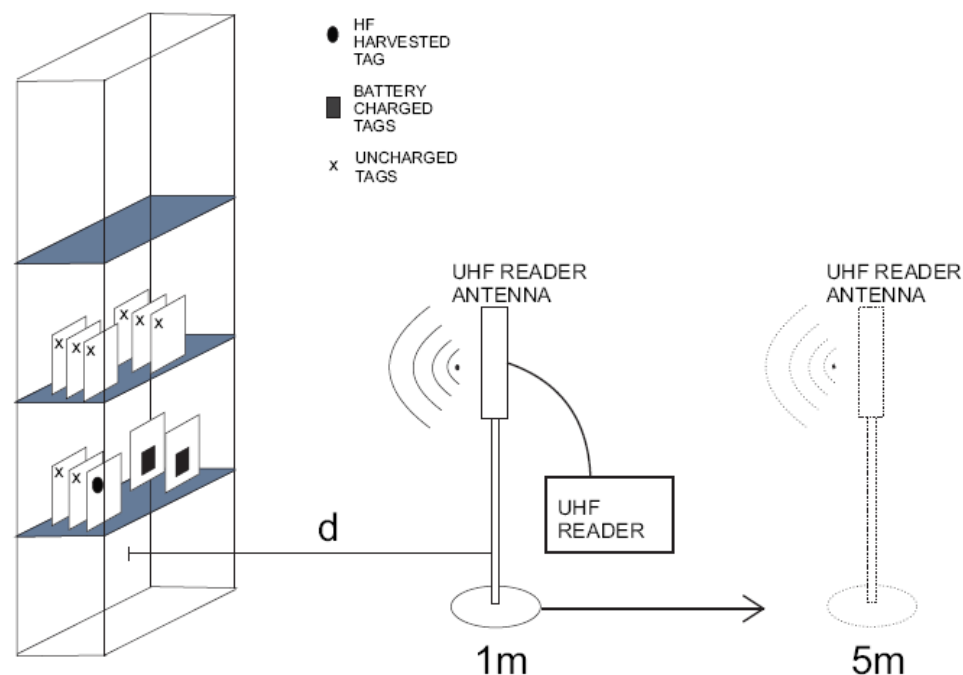
[1] P. Toli, M. Bofli -Kudri, M. Russo, N. Rofli, "Extending the Reading Region of the RFID UHF Gen2 System by HF/UHF Integration", *Proceedings of the 12th International Conference on Telecommunications (ConTEL 2013)*, p.p. 257-261



HF/UHF integracija [1]



Slika: Mjerno okruŹje



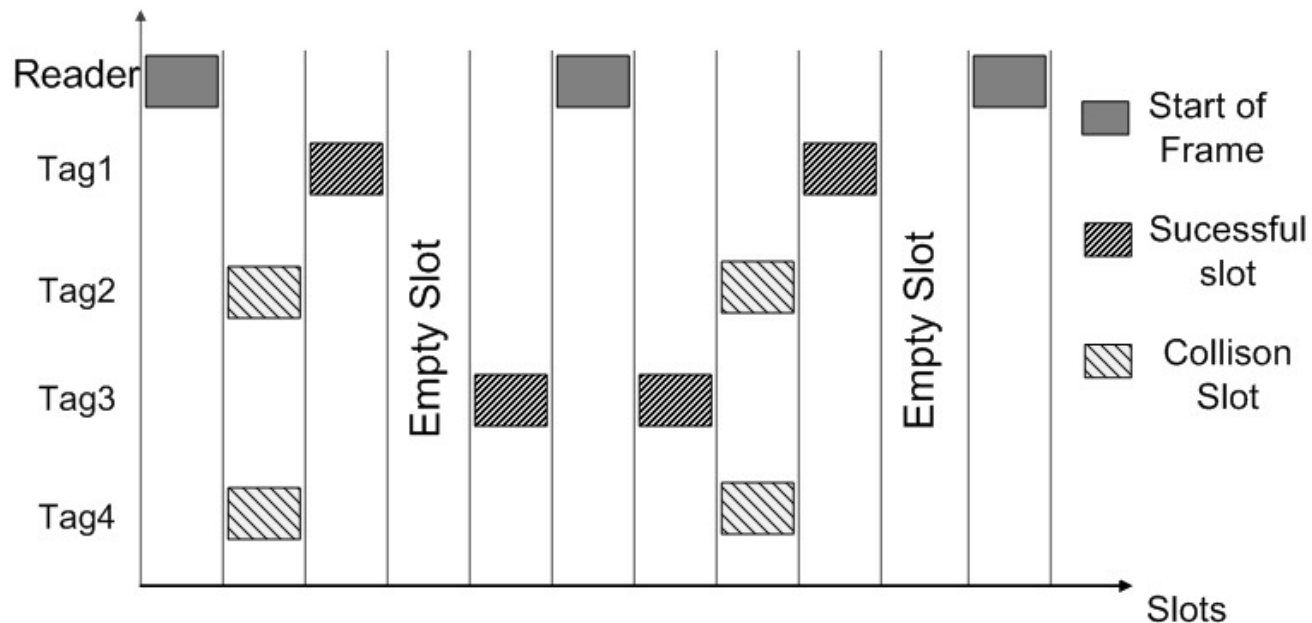
“ HF/UHF integrirani tagovi se ponašaju kao BAP tagovi

[1] P. Toli, M. Boffi -Kudri, M. Russo, N. Roffi, „Extending the Reading Region of the RFID UHF Gen2 System by HF/UHF Integration“, *Proceedings of the 12th International Conference on Telecommunications (ConTEL 2013)*, p.p. 257-261



ALOHA i RFID

- ” Pristup dijeljenom mediju (eng. Medium Access Control)
- ” Tagovi – Štedljivo računanje
- ” Prazni (*E*), Uspješno pročitani (*S*) i kolizijski (*C*) vremenski odsječki



Slika: Dynamic Frame Slotted ALOHA (DFSA) prilagođen za RFID sustav. Veličine okvira su ograničene na vrijednosti 2^Q , $0 \leq Q \leq 15$

ALOHA i RFID

Vogt [1]:

$$\varepsilon_{vd} = \min_n \left[\binom{e}{s} - \binom{E}{S} \right] = \min_n ((e-E)^2 + (s-S)^2 + (c-C)^2)$$

Chen [2]:

$$p(E, S, C | n) = \frac{L!}{E!S!C!} p(E)^E p(S)^S p(C)^C$$

$$\hat{n} = \arg \max_n (p(E, S, C | n))$$

Floerkermeier [3]:

$$p(E, S, C | n) = \frac{L!}{E!S!C!} \frac{T(E, S, C, n)}{L^n}$$

$$\hat{n} = \arg \max_n (p(E, S, C | n))$$

$T(E, S, C, n)$ je opisan dan kao koeficijent uz $\frac{x^n}{n!}$ ekspanzije $G(x)$

$$G(x) = \left(\frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \dots \right)^C$$

$$G(x) = (e^x - (1-x))^C x^S$$

Vahedi [4]:

$$p(E, S, C | n) = \frac{L!}{E!S!C!} P_1(E) P_2(S | E) P_3(C | E, S)$$

$$\hat{n} = \arg \max_n (p(E, S, C | n))$$

$$P_1(E) = \left(1 - \frac{E}{L} \right)^n$$

$$P_2(S | E) = \binom{n}{S} \frac{(L-E-S)^{(n-S)}}{(L-E)^n} S!$$

$$P_3(C | E, S) = \sum_{k=0}^C \sum_{v=0}^{C-k} (-1)^{(k+v)} \binom{C}{k} \binom{C-k}{v} \frac{(n-S)! (C-k-v)^{(n-S-k)}}{(n-S-k)! C^{(n-S)}}$$

[1] H. Vogt, "Efficient object identification with passive rfid tags", in Proc. Int. Conf. Pervasive Computing, 2002, pp. 98–113.

[2] W.-T. Chen, "An accurate tag estimate method for improving the performance of an rfid anticollision algorithm based on dynamic frame length aloha", IEEE Transactions on Automation Science and Engineering, vol. 6, no. 1., pp. 9–15, 2009.

[3] C. Floerkemeier, "Bayesian transmission strategy for framed aloha based rfid protocols," in IEEE RFID 2007., pp. 228–235

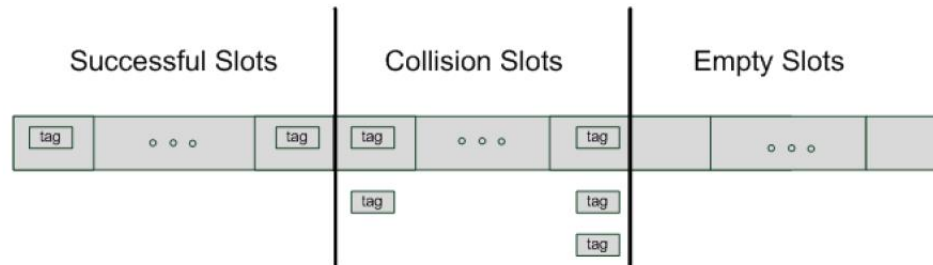
[4] E. Vahedi, V. W. Wong, I. F. Blake, and R. K. Ward, "Probabilistic analysis and correction of chen's tag estimate method,"

IEEE Transactions on automation science and engineering, vol. 8, pp. 659–663, July 2011.



ALOHA i RFID

1. Poredati slotove:



2. Izraz za vjerojatnost:

$$p(E, S, C | n) = \frac{L!}{E!S!C!} \frac{N_S(n, S) N_C(n, S, C)}{L^n}$$

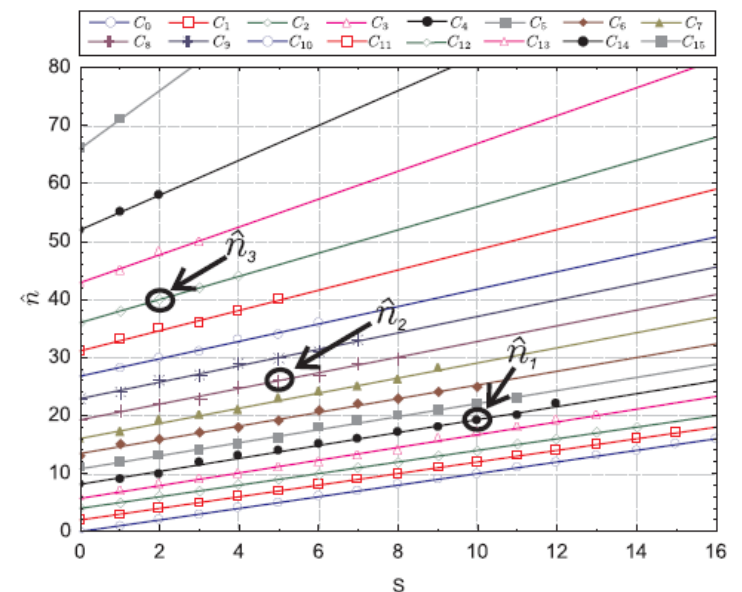
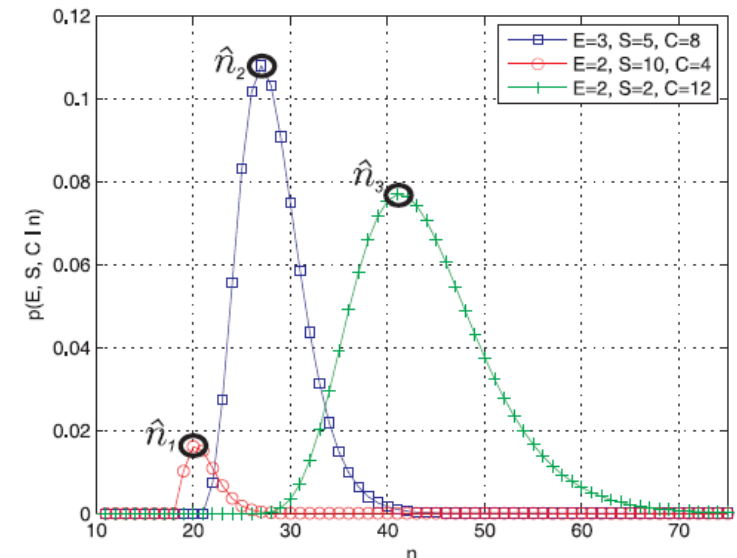
$$\hat{n} = \arg \max_n (p(E, S, C | n))$$

$$N_S(n, S) = \frac{n!}{(n-S)!}$$

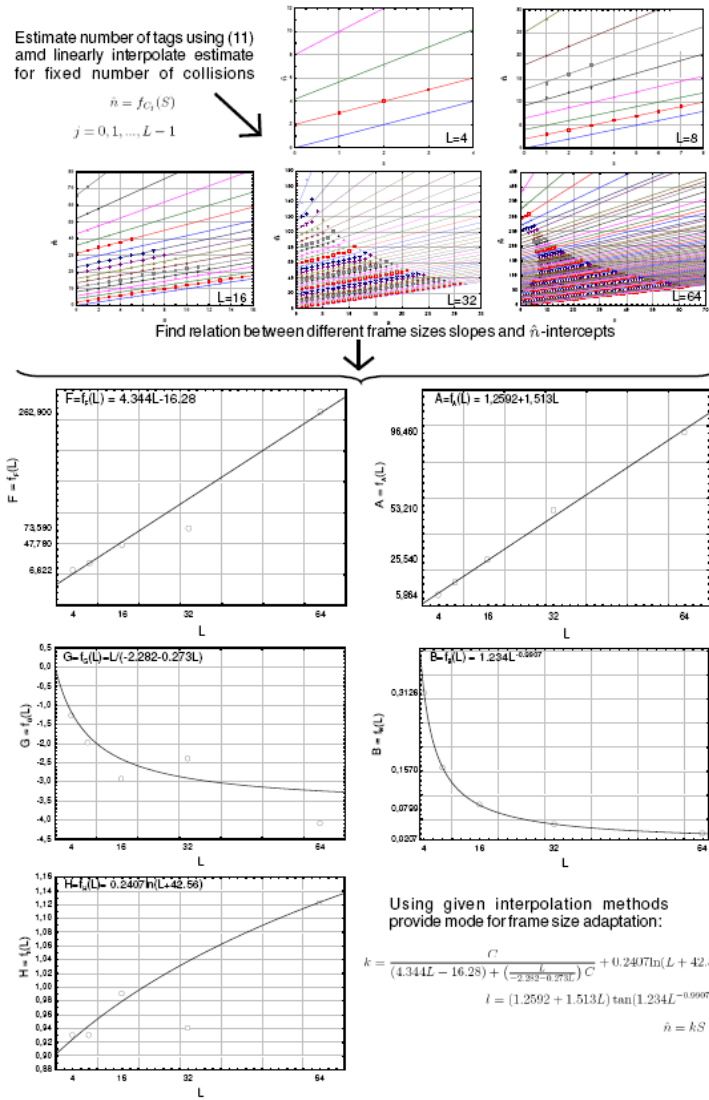
$N_C(n, S, C)$ je opisan dan kao koeficijent uz $\frac{x^n}{n!}$ ekspanzije

$$\left(\frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \dots \right)^C = (e^x - (1-x))^C$$

3. Oblik:



ILCM algoritam [1]



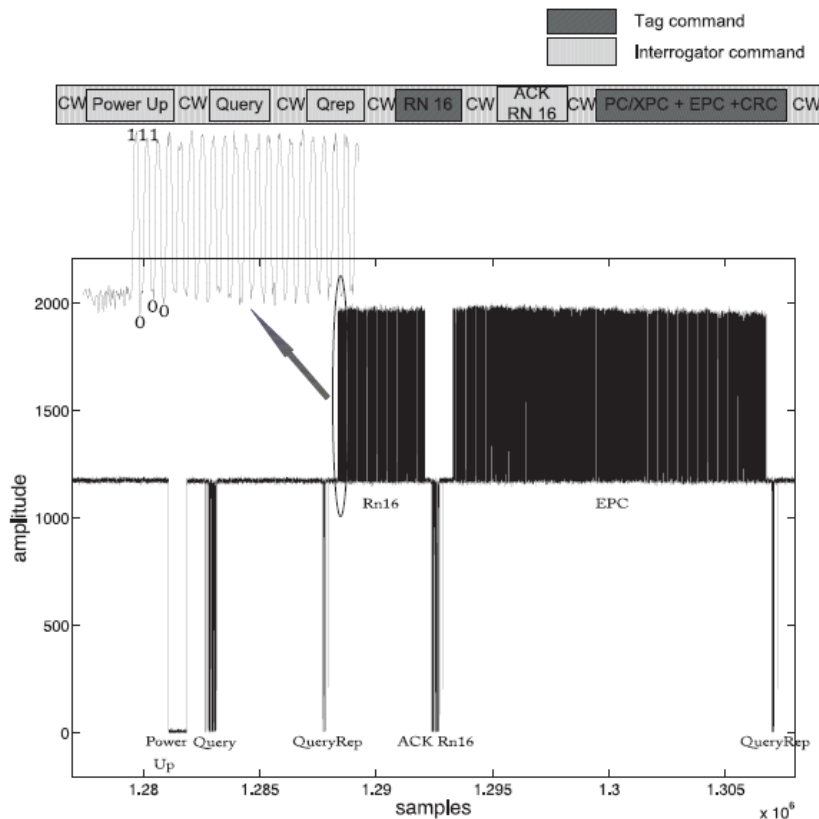
Pojednostavljeno (ILCM -aproksimacija):

$$k = \frac{C}{(4.344L - 16.28) + \left(\frac{L}{-2.282 - 0.273L}\right)C} + 0.2407 \ln(L + 42.56)$$

$$l = (1.2592 + 1.513L) \tan(1.234L^{-0.9907} C)$$

$$\hat{n} = kS + l$$

ALOHA – vrijeme [1]

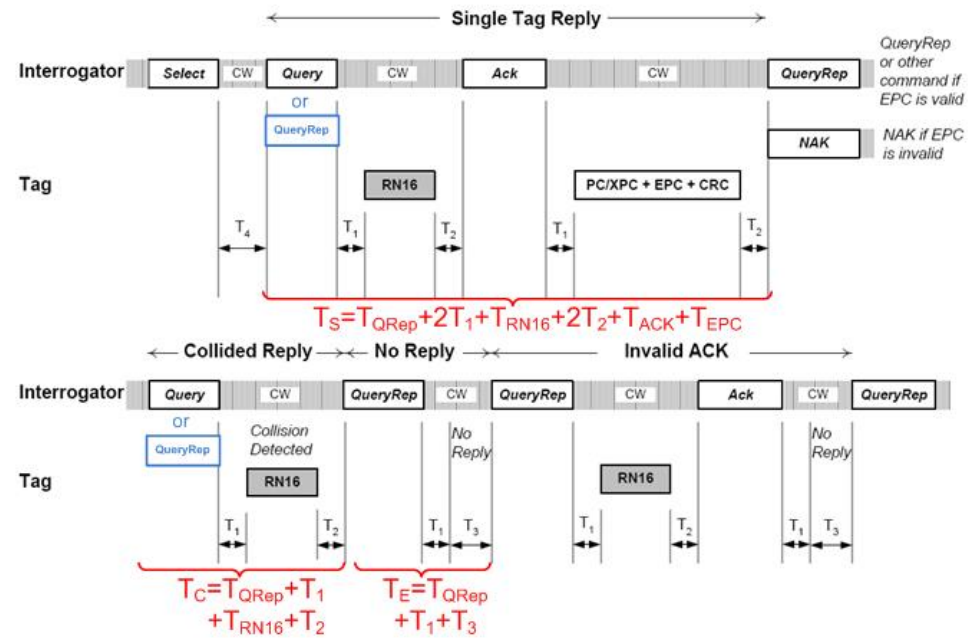


propusnost ALOHA sustava

$$\eta = \frac{S}{L}$$

broj pro itanih tagova u sekundi

$$\text{tagova u sekundi} = \frac{S}{\text{trajanje } L - a} = \frac{S}{ET_E + ST_S + CT_C}$$



Parameter	Duration	Parameter	Duration
Tari	24μs	T3	4.7ms
RTCali	72μs	PRT	0.3ms
BLF	40kHz	TFS	98μs
T1	162.5μs	T _{Query}	0.264ms
T2	1.1ms	T _{ACK}	0.75ms
TRExt	1	T _{QRep}	0.25ms
M	4	T _S	22.5ms
T _{RN16}	3.9ms	T _C	5.4ms
T _{EPC}	15.1ms	T _E	4.7ms

Slika: Vremenske postavke protokola

[1] P. Šolić, M. Šarić, M. Stella, "Tags/s - RFID reader-tag communication throughput using Gen2 Q-algorithm frame adaptation scheme", ECCS'13, pp. 100-105

Zaključak

- “ RFID tehnologija – općenito
- “ UHF/HF integracija
- “ ALOHA i RFID – simulacija i mjerenje

