Efficient LTE Access with Collision Resolution for Massive M2M Communications [1]

Yin-Hong, Hsu

10 11, 2016

Outline

Aim

Background

Proposed solution

Result

References

Aim

- **Propose a LTE RACH scheme for delay-sensitive M2M service with synchronous trafiic arrivals**
- **Propose a to use collision resolution algo. to resolve synchronous RACH attemp**
  - it is more efficient to resolve these collisions instead to waste time and LTE resources by trying to avoid them

Background

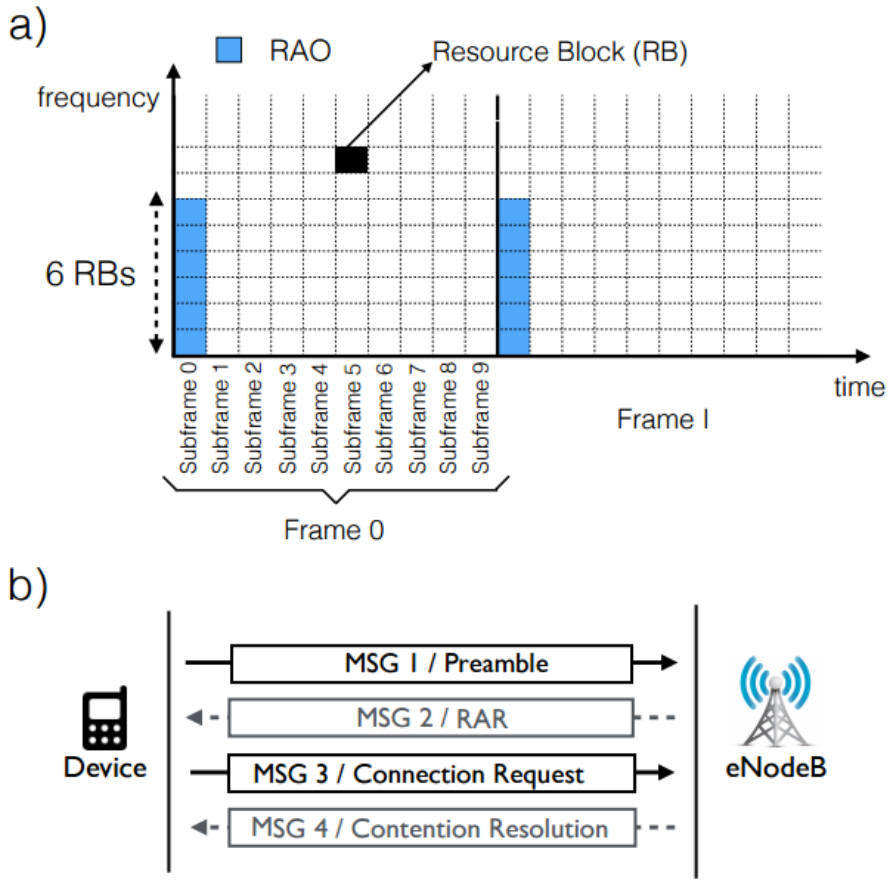

Fig. 1. a) LTE uplink resources with one RAO per frame. b) Message exchange between a device and the eNodeB during the LTE random access procedure.

Background

- Time is divided in frames, every frame is composed by 10 subframes
- There are 64 orthogonal preambles in LTE, some of them are reserved for special purposed
  - The actual number of available preambles for contention is typically set to 54
- eNodeB can only detect if a preamble has been actived or not, but not how many device have actually activated it

Proposed solution

- Propose to use a q-ary tree splitting algo.
- It perform through the feedback messages sent by eNodeB
- propose a new type of MSG4, denoted as MSG4b

Proposed solution
LTE RACH Modification

- MSG4b specifying the details of the next contention attempt
  - MSG4b indicates a set of q preambles to be used for the next contention attemptand the RAO where this contention should take place

Proposed solution
LTE RACH Modification

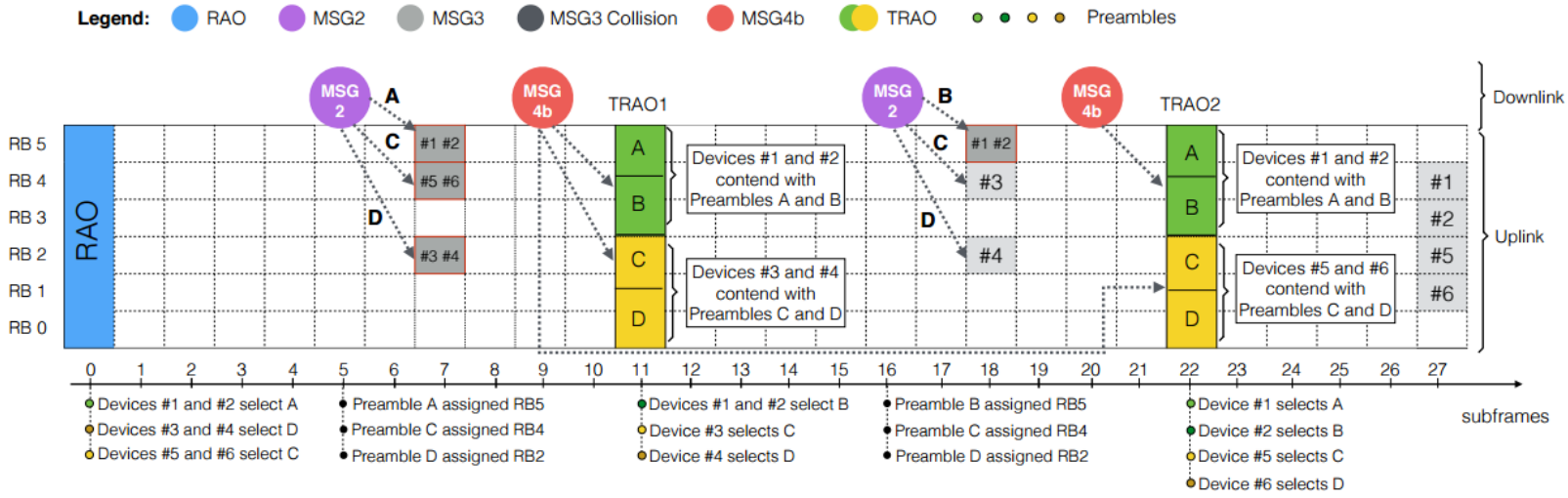

Fig. 2. Illustration of the proposed tree-splitting algorithm.

Proposed solution
LTE RACH Modification

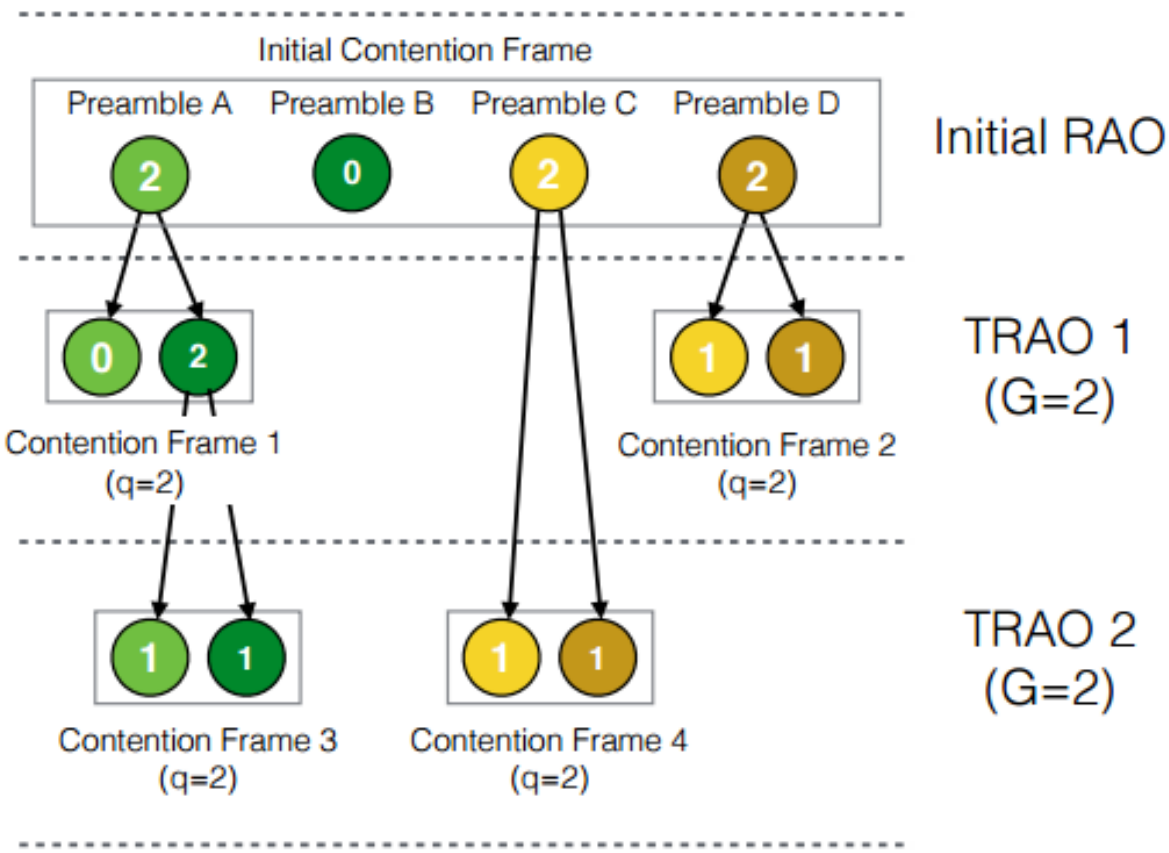

Fig. 4. Illustration of contention resolution with four devices and four preambles.

Result

Parameter	Value	Parameter	Value
Total Number of Preambles (N_P)	54	MSG 2	56 bits
MSG 2 Window (t_{RAR})	5 ms	MSG 4	20 bits
MSG 4 Timer	24 ms	MSG 4b	25 bits
Maximum Transmissions (M)	10	System BW	20 MHz
Contention Timer (t_{CRT})	48 ms	Backoff (B_i)	20 ms
eNodeB and UE Processing Time	3 ms	Modulation	QPSK

TABLE I
SYSTEM PARAMETERS.

Result

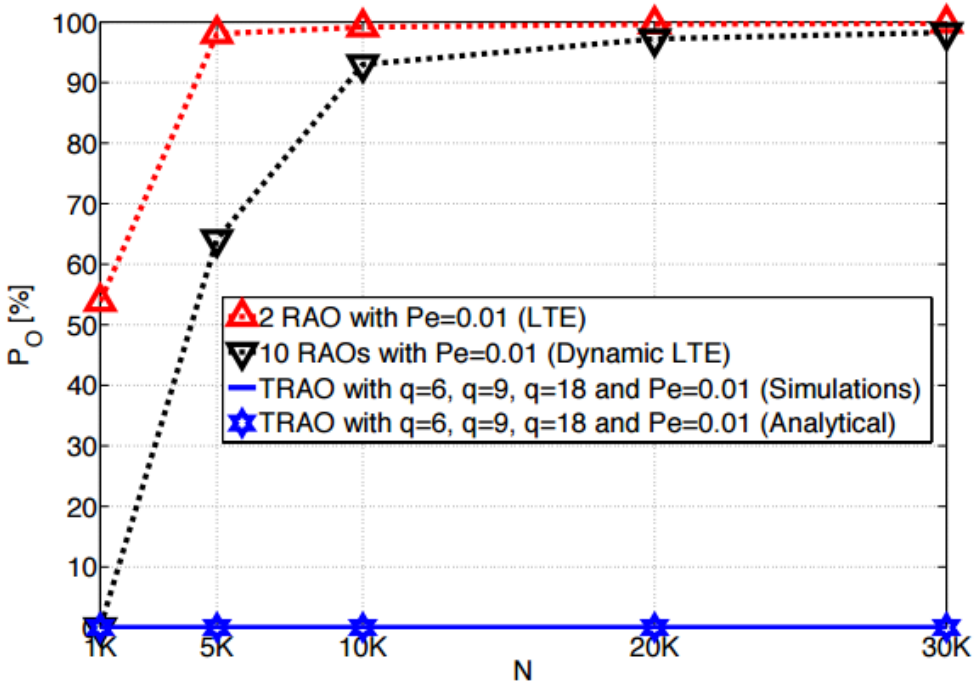

Fig. 5. Outage performance of standard LTE RACH, dynamic allocation and the proposed splitting-tree.

Result

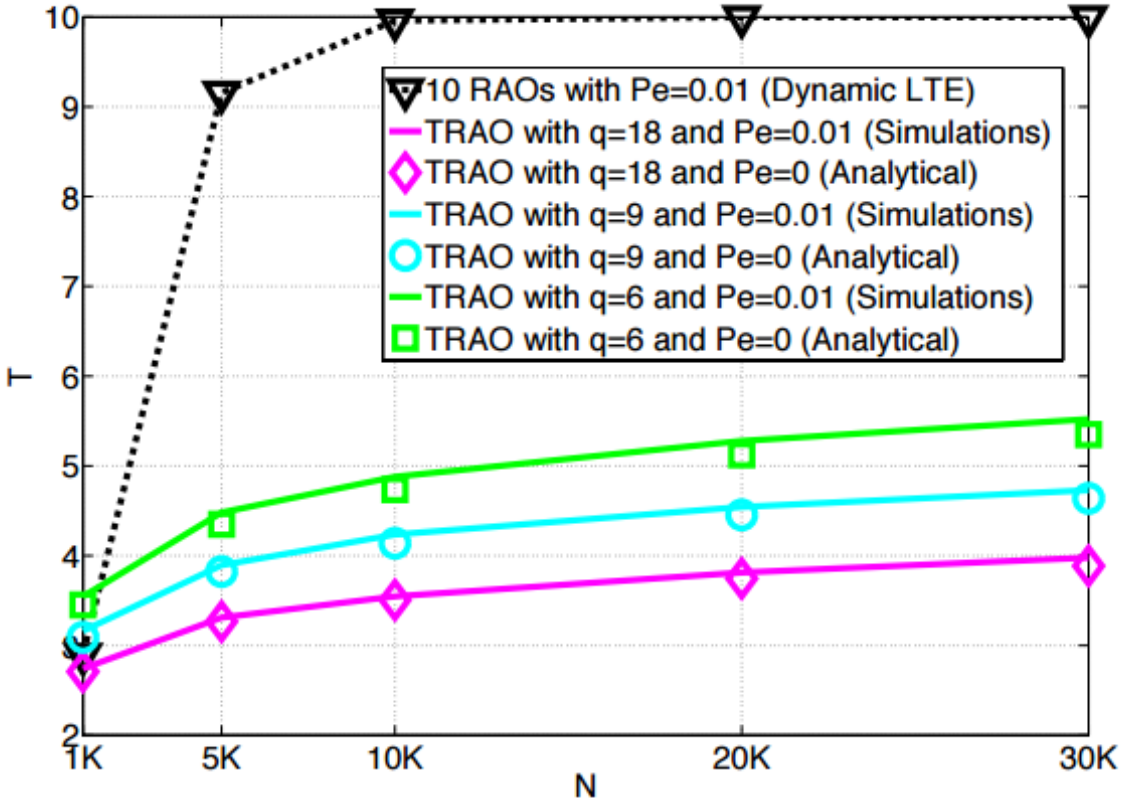

Fig. 6. Average preamble transmissions per device required.

Result

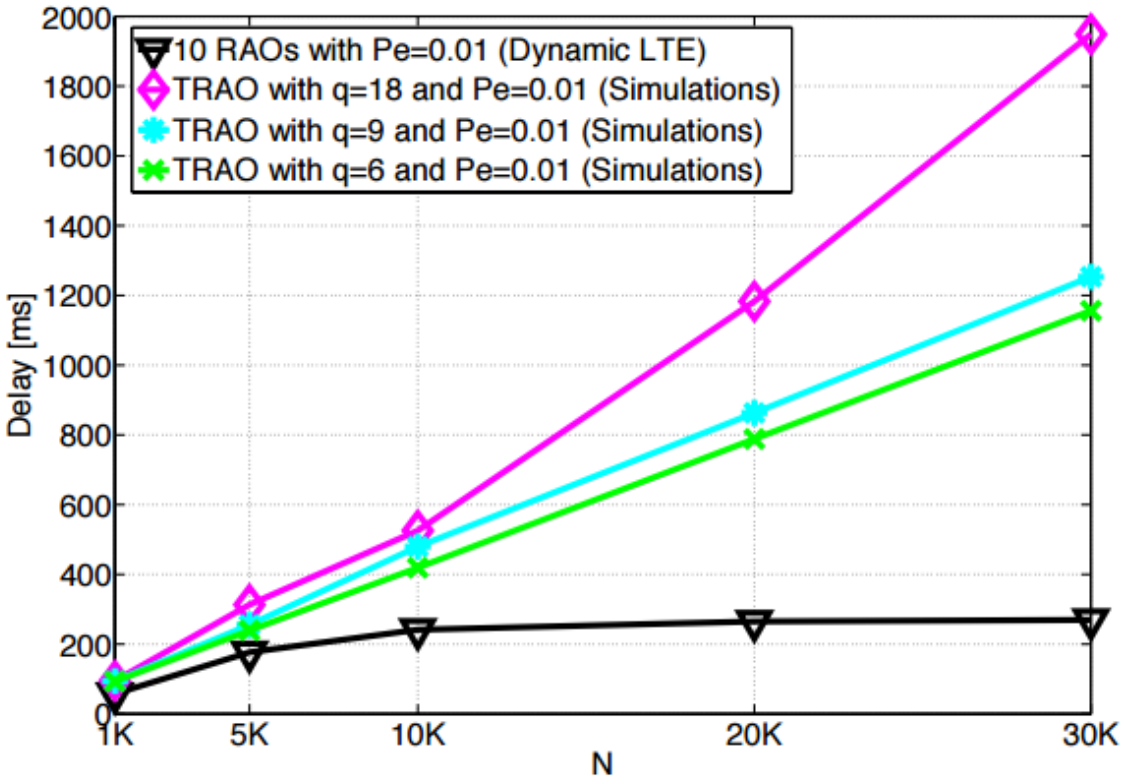

Fig. 7. Average delay experienced by resolved devices.

Result

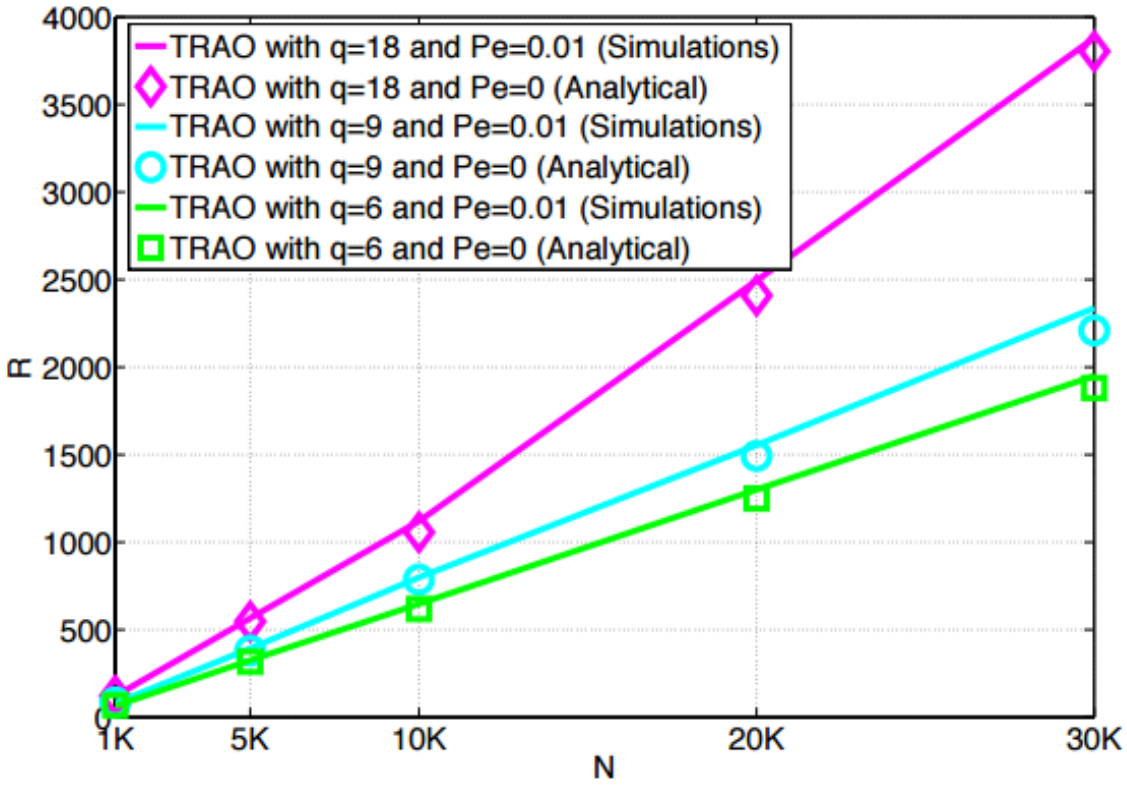

Fig. 8. Average number of TRAOs required.

References

[1] C. P. P. Madueo, Germn Corrales; Stefanovic, “Efficient lte access with collision resolution for massive m2m communications,” in *IEEE GLOBECOM*, 2015.

Thanks for Your Attentions