Optimal Resource Dedication in Grouped Random Access for Massive Machine-Type Communications [1]

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Outline

Introduction

Resource Allocation In Grouped Random Access

Optimized Random Access Channel Resource

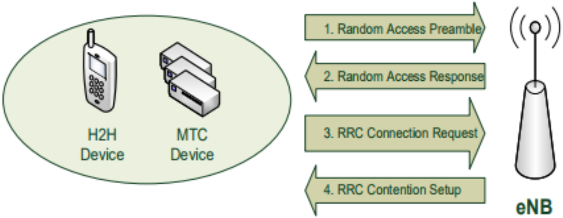
Simulation

References

Background

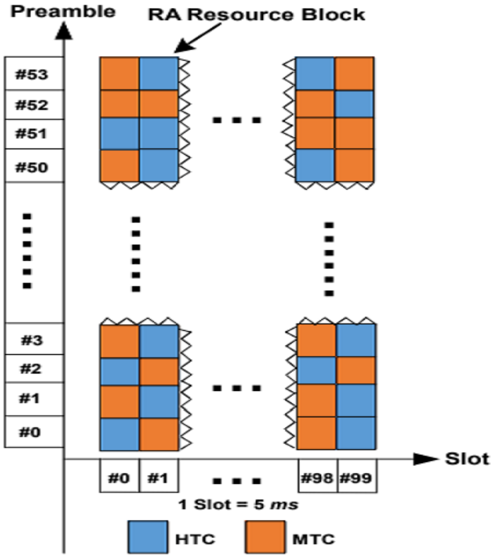
- To Support massive Machine Type Communication (mMTC), Radio Access Network congestion is one of the most important issue.
- RAN congestions are caused by Random Access collisions

Random Access Procedure



RA resource seperation

- The RA resource seperation scheme is different to ACB.
- It can decouple the collision rate problem between HTC and MTC.



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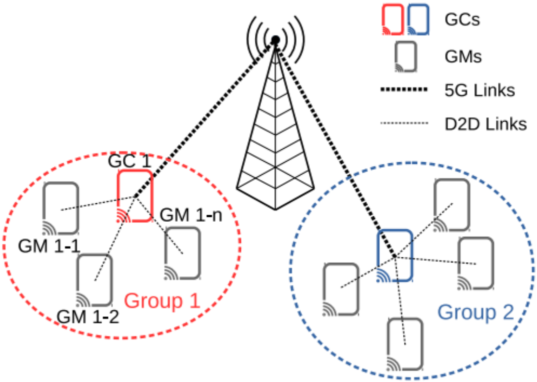
Grouped RA

- This study is based on D2D-based grouped RA
- Each group with a GC and several GM
- The group is clustered by device class (DC)

Grouped RA



Allocation strategy

- RACH resource can be flexibly allocate to different DC
- The allocation strategy can be concluded into three category
  - full sharing
  - full dedication
  - partial dedication

Allocation strategy

- Full sharing strategy is inflexible.
- This work is focus on full dedicate way.

parameter in the algorithm

- L: number of RAOs
- N: number of classes
- r_i: average RA requests for each DC
- ρ_i: collision rate for each DC

initialize $L, N, \gamma_1, \gamma_2, \ldots, \gamma_N, \hat{p}_1, \hat{p}_2, \ldots, \hat{p}_M$;
for $i = 1$ *to* M **do** *Reserve RAOs for special DCs*
    $L_i \leftarrow -\gamma_i / \ln(1 - \hat{p}_i)$;
    $L \leftarrow L - L_i$;
    if $L < 0$ **then**
        Exception: RACH resource overload
    end
end
for $i = M + 1$ *to* N **do** *Allocate the rest RAOs*
    $L_i \leftarrow L\gamma_i / \sum_{j=M+1}^{N} \gamma_j$;
end

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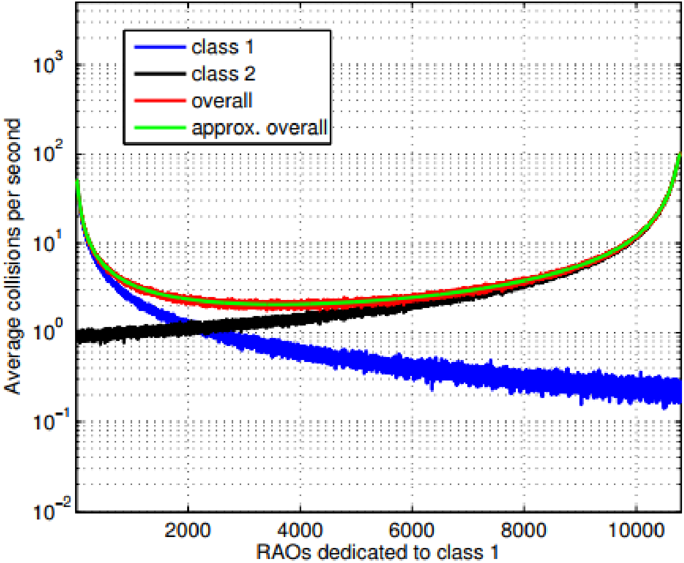
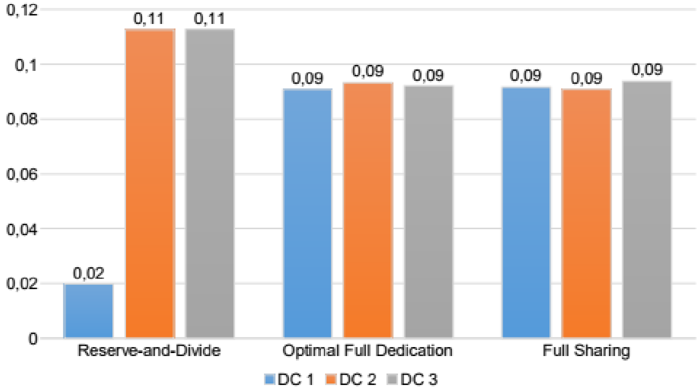
Class	Accessing devices	Avg. access frequency	RA density
1	3000	1/60 Hz	50 Hz
2	30 000	1/300 Hz	100 Hz
3	30 000	1/60 Hz	500 Hz
4	30 000	1/30 Hz	1000 Hz


class 1
class 2
overall
approx. overall
Average collisions per second
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
10^{-2}
2000
4000
6000
8000
10000
RAOs dedicated to class 1

DC Combination	1&2	1&3	1&4
Optimal. L_1 (estimated)	3600	982	514
Optimal. L_1 (simulated)	3460	1048	534
Collision density at est. opt. L_1 (Hz)	1.766	26.320	95.690
Collision density at sim. opt. L_1 (Hz)	1.998	26.780	97.042
Collision density under full sharing (Hz)	2.166	26.940	97.634



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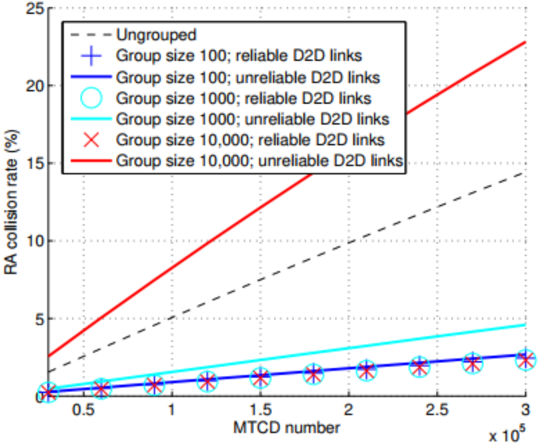
D2D-based grouping result [2]



References

[1] B. Han, M. A. Habibi, and H. D. Schotten, “Optimal resource dedication in grouped random access for massive machine-type communications,” Jul 2017.

[2] B. Han, O. Holland, V. Sciancalepore, M. Dohler, and H. D. Schotten, “D2d-based grouped random access to mitigate radio access network congestion in massive machine-type communications,” May 2017.