Radio Resource Management for In-Airplane Communication

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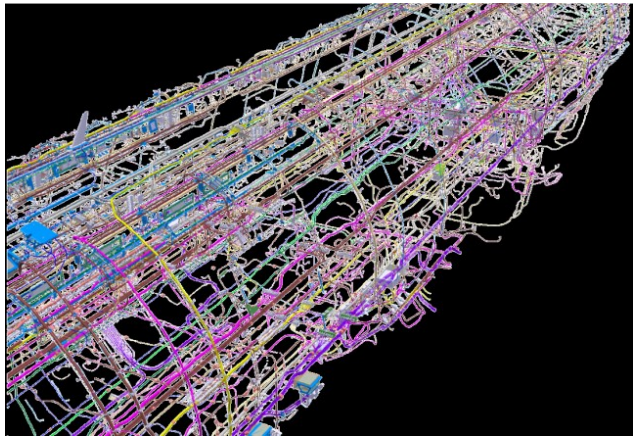
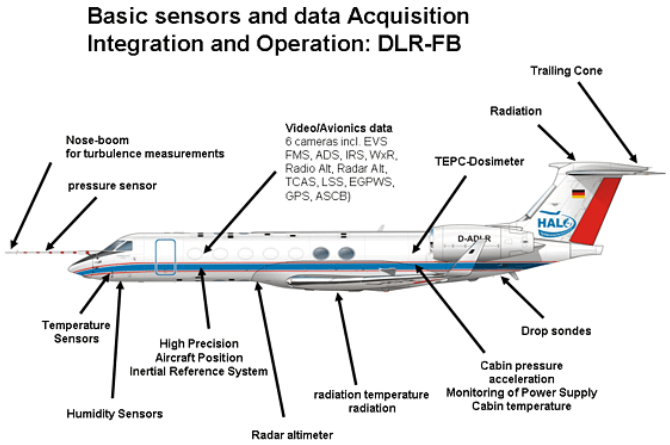
Why Wireless



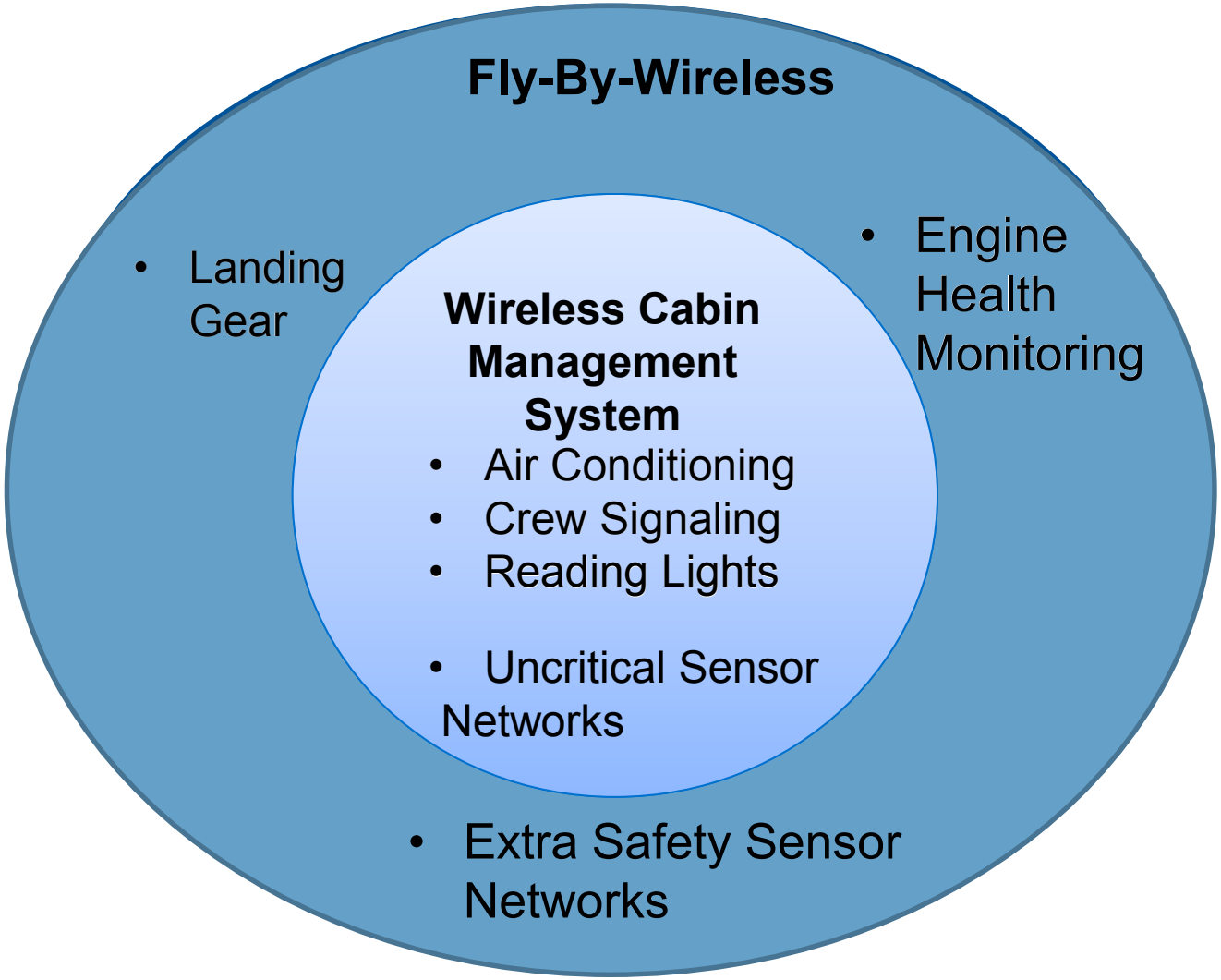


- Reduce wiring
- Simplified maintenance
- Flexible communication architecture

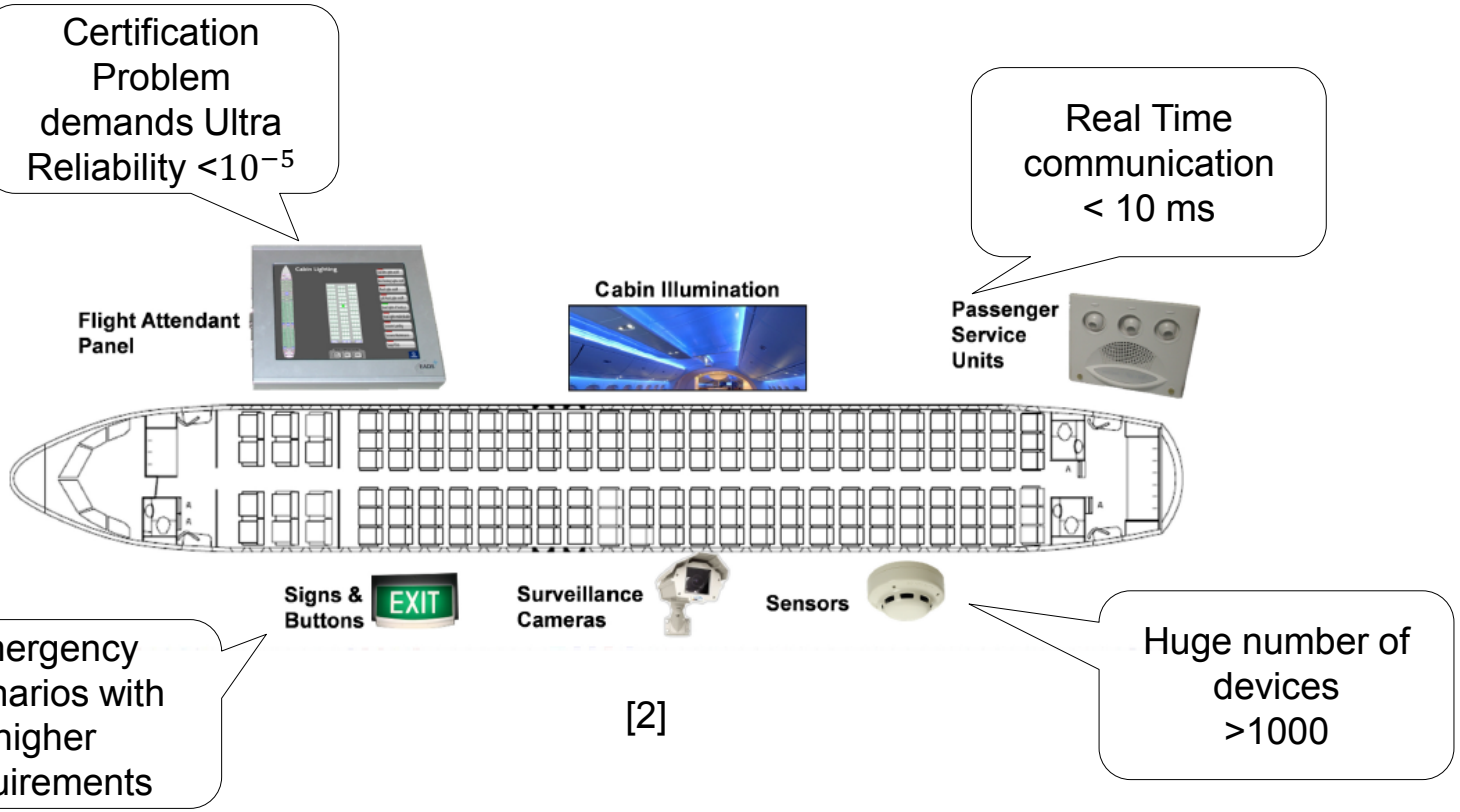
https://commons.wikimedia.org/wiki/File:US_Navy_090622-N-6720T-015_Aviation_Machinist%27s_Mate_1st_Class_James_Gregorio,_assigned_to_the_jet_engine_shop_in_the_aviation_intermediate_maintenance_department,_installs_a_wiring_harness_on_an_F-A-18E_Super_Hornet_engine.jpg

http://www.halo.dlr.de/instrumentation/basis.html

How


Fly-By-Wireless
• Landing Gear
• Engine Health Monitoring
Wireless Cabin Management System
• Air Conditioning
• Crew Signaling
• Reading Lights
• Uncritical Sensor Networks
• Extra Safety Sensor Networks

What do we need

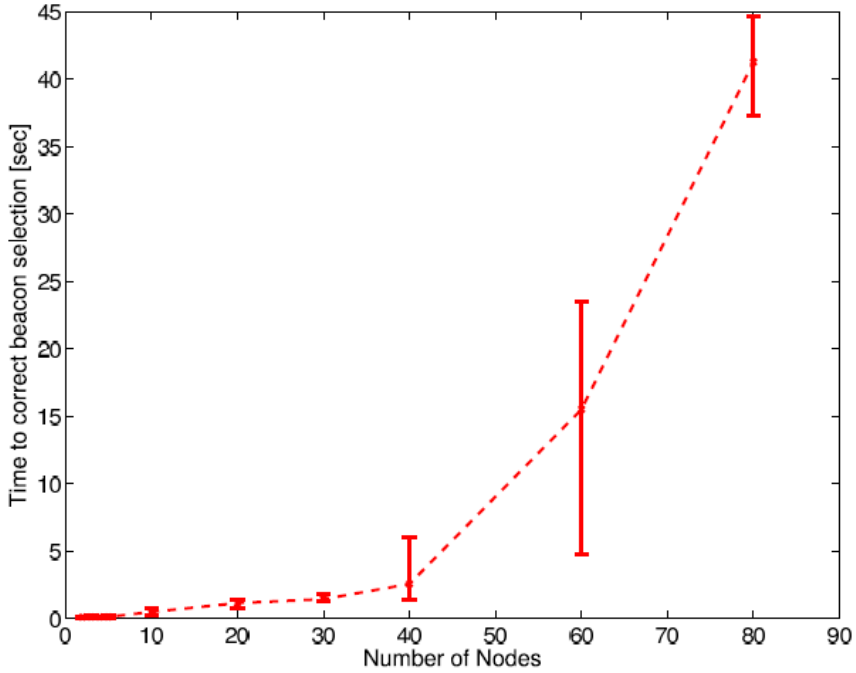


[2] Wireless UWB Aircraft Cabin Communication System, 2011, Frank M. Leipold, Doctoral Thesis, TUM EADS, Germany

M2M device traffic in Aircraft

- In case of an alarm or power shortage recovery, simultaneous synchronization requests will take place
- 1500 nodes for test measurements
- 800 nodes for PAX Localization and Tracking
- Nearly 5k total in A380
- A lot more in future aircrafts

Previous Work for Aircraft Random Access



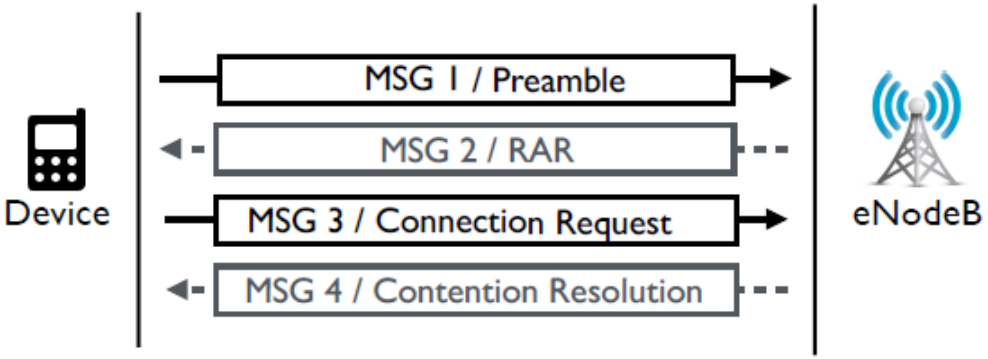
[2]

- UWB 8 free beacon slots for joining the channel
- 1 superframe 65 ms
- No collision handling just random backoff
- Limits the system 40 nodes per base station
- Dimensioning without considering sensor nodes

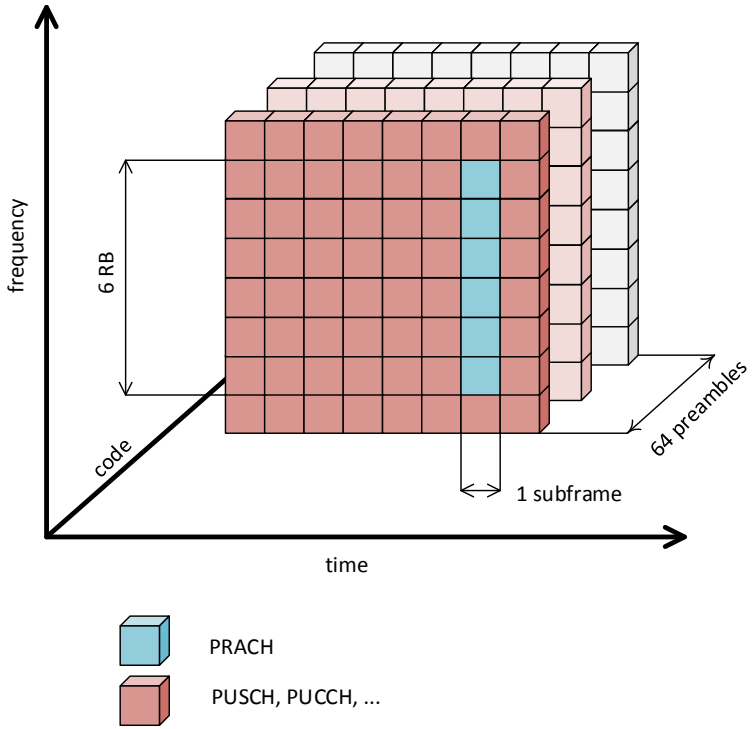
[2] Wireless UWB Aircraft Cabin Communication System, 2011, Frank M. Leipold, Doctoral Thesis, TUM EADS, Germany

LTE RACH

- LTE-U chip possibility

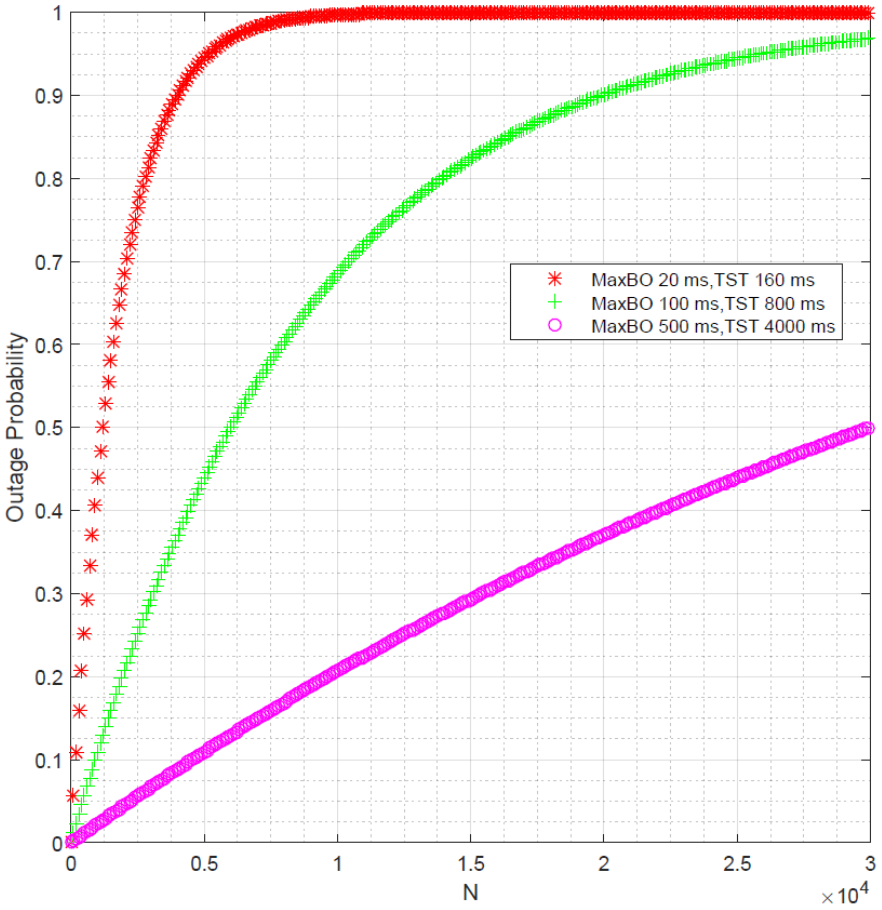


- Collision detected at MSG 3
- Fixed Access Barring
- Fixed Max Backoff



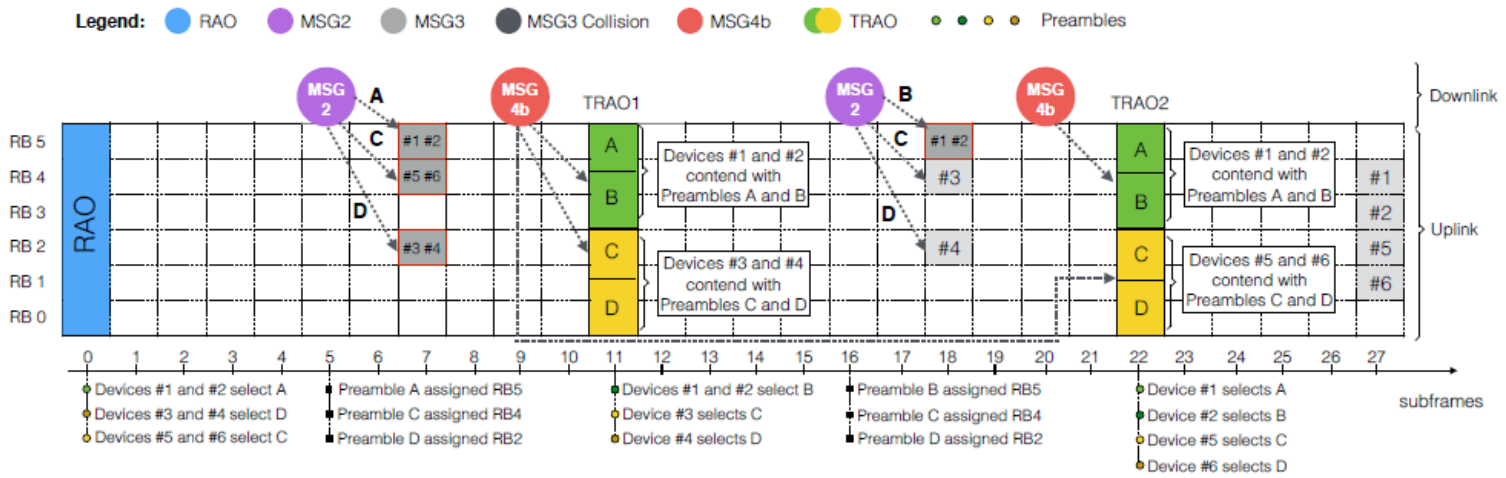
Standard LTE on M2M

- Max. Retrials 8 [4]
- Preambles 54 [3]
- PRACH Configuration Index 6
- Safe choice would be up to 5000 users and 4 seconds.

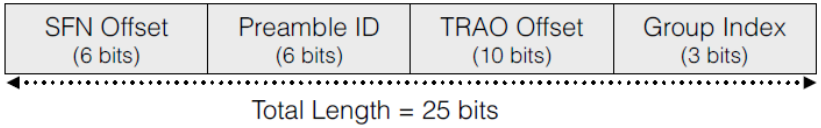


[4] R. R. Tyagi, F. Aurzada, K. Lee, and M. Reisslein, “Impact of Retransmission Limit on Throughput and Delay of Preamble Contention in LTE-Advanced Random Access” no. May, pp. 0–23, 2012.
[3] 3GPP, “R2-105212 MTC simulation assumptions for RACH performance evaluation.” TR R2-105212, Aug. 2010.

Tree algorithm on M2M 1/2



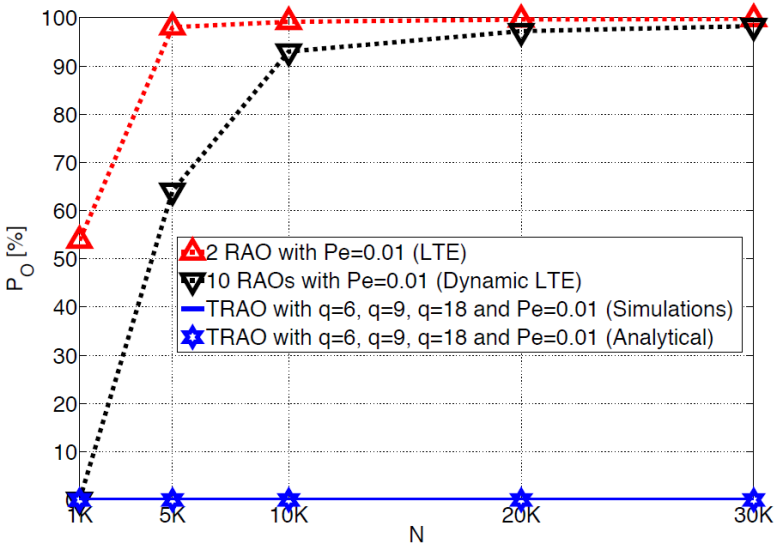
[9]

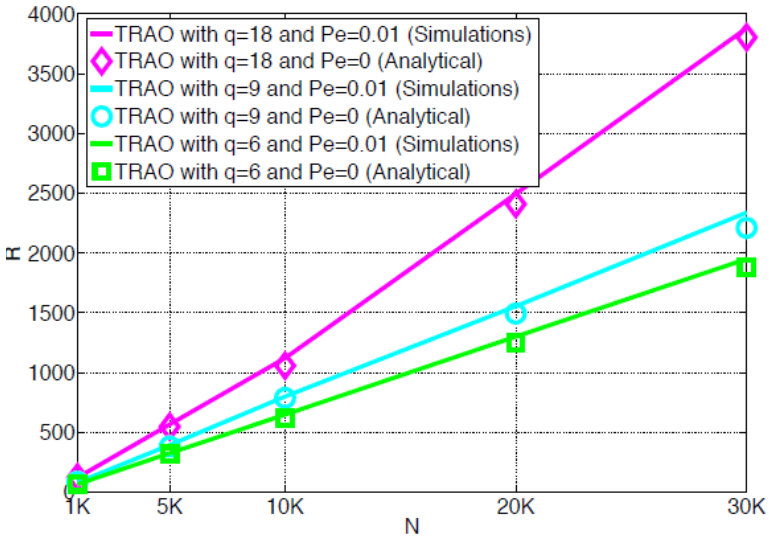


- Modified new message 4b for **collision resolution**
- G groups with q preambles
- Dedicated preamble group and time offset for collided requests

[9] P. Popovski, “Efficient LTE Access with Collision Resolution for Massive M2M Communications.” *Globecom Workshops (GC Wkshps), 2014* , vol., no., pp.1433,1438, 8-12 Dec. 2014

Tree algorithm on M2M 2/2





[9]

- Decrease outage and instability due to coordination
- Increase reliability with sacrificing latency
- Still room for improvement in terms of RACH utilization

[9] P. Popovski, “Efficient LTE Access with Collision Resolution for Massive M2M Communications.” *Globecom Workshops (GC Wkshps), 2014* , vol., no., pp.1433,1438, 8-12 Dec. 2014

Conclusion

- Aim
  - Ensuring reliability with least amount of delay sacrificed
  - Testing the limits of the RACH of LTE
  - Different RACH behavior for M2M and others
- Method
  - M2M synchronous arrivals can be used as an advantage
- Vision
  - Massive M2M in future

Questions?

List of References

[1]	EUWB Deliverable D8a.1 Scenario description for public transport applications, S. Bovelli F. Leipold, 2011
[2]	Wireless UWB Aircraft Cabin Communication System, 2011, Frank M. Leipold, Doctoral Thesis, TUM EADS, Germany
[3]	3GPP, “R2-105212 MTC simulation assumptions for RACH performance evaluation.” TR R2-105212, Aug. 2010.
[4]	R. R. Tyagi, F. Aurzada, K. Lee, and M. Reisslein, “Impact of Retransmission Limit on Throughput and Delay of Preamble Contention in LTE-Advanced Random Access” no. May, pp. 0–23, 2012.
[5]	M. Tavana, V. Shah-mansouri, and V. W. S. Wong, “Congestion Control for Bursty M2M Traffic in LTE Networks.”
[6]	S. Duan, V. Shah-mansouri, and V. W. S. Wong, “Dynamic Access Class Barring for M2M Communications in LTE Networks,” pp. 4876–4881, 2013.
[7]	Y. Birk and Y. Keren, “Judicious Use of Redundant Transmissions in Multichannel ALOHA Networks with Deadlines,” IEEE J. Sel. Areas Commun., vol. 17, no. 2, pp. 257–269, 1999.
[8]	J. Capetanakis, “Tree algorithms for packet broadcast channels,” IEEE Trans. Inf. Theory, vol. 25, no. 5, 1979.
[9]	P. Popovski, “Efficient LTE Access with Collision Resolution for Massive M2M Communications.” *Globecom Workshops (GC Wkshps), 2014* , vol., no., pp.1433,1438, 8-12 Dec. 2014