Coexistence of H2H and M2M types of connections in LTE technology

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Objectives

Requirements:
- Enabling M2M communication
- Satisfying "Plug&Play" principle

Solution:
Exploiting LTE network

Question: Is LTE able to support both M2M and H2H communications?

Objective: Simulating a Smart City scenario and testing network performances with NS3
NS3’s LENA module was designed as connection-oriented.

- Didn’t support Connection Release, only handovers.
- Many devices
  - We need Connection Release!
  - SRS Periodicity needed to be increased!
Self-intercommunicating devices $\Rightarrow$ IoT and Smart-Cities
Huge growth: $+34\%$ annual from 2016 to 2021 (Cisco)
50,000 devices per cell site (3GPP)

Features:
- short packets
- small # packets
- uplink-dominant
- low duty-cycle packets

$\Downarrow$

5G requirements are outlined
Communications between humans: Smartphones, Laptops, Modems. HTCs provide different type of services (VoIP, Video-Streaming, Gaming,...)

Heterogeneous traffic:
- Packets of different sizes
- Variable number of packets per transmission
- No evident temporal statistic for the access on the channel

Inter-arrival time of RACH request

\[ f(x) = \sum_{c=1}^{C} \alpha_c \lambda_c e^{-\lambda_c x} \]

G. Foddis, R. G. Garropppo, “On RACH preambles separation between human and machine type communication”
System Model

M2M Periodic Traffic Model (3GPP)
- APP-layer payload size → Pareto distribution ($\alpha = 2.5$, [20, 200] Bytes)
- Header = 65 Bytes (CoAP, DTLS, UDP and IP headers)
- Half of devices has ACK in downlink (payload size = 0)

H2H Traffic Model (UMTS study)

We built a custom On-Off application to model Hyper-exp inter-arrival and:
Three Scenarios:

Simulation Time = 30 min
Scale-down from 50,000 (3GPP) to 400 MTDs

1) H2H only: 100, 200, 400, 800
2) H2H: 400
   M2M with transmission period = 90 s: 50, 100, 200, 400
3) H2H: 400
   M2M: 200
   M2M transmission period: 8, 15, 30, 60, 90 s

Measured performances:

- Packet-loss
- Average end-to-end delay
- Total throughput
- User throughput
H2H Results

- Average e2e Delay
  - H2H Only
  - Varying period
  - Varying #MTDs
H2H Results

Varying #MTDs

Varying period

Varying #MTDs

H2H Only
Conclusions

M2M communications do not seem to have a great impact on the network performances, excluding extreme cases

Future Works and Improvements

– Modeling H2H downlink traffic
– Implementing M2M traffic following exactly 3GPP standards:
  · \( \sim 50,000 \) MTDs per hex-sector
  · MTDs express a periodic traffic with different periods
  · Poisson Traffic
– Considering a bigger scenario