A Simulation Study on the Impact of IoT Traffic in a Smart-city LTE Network

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Abstract

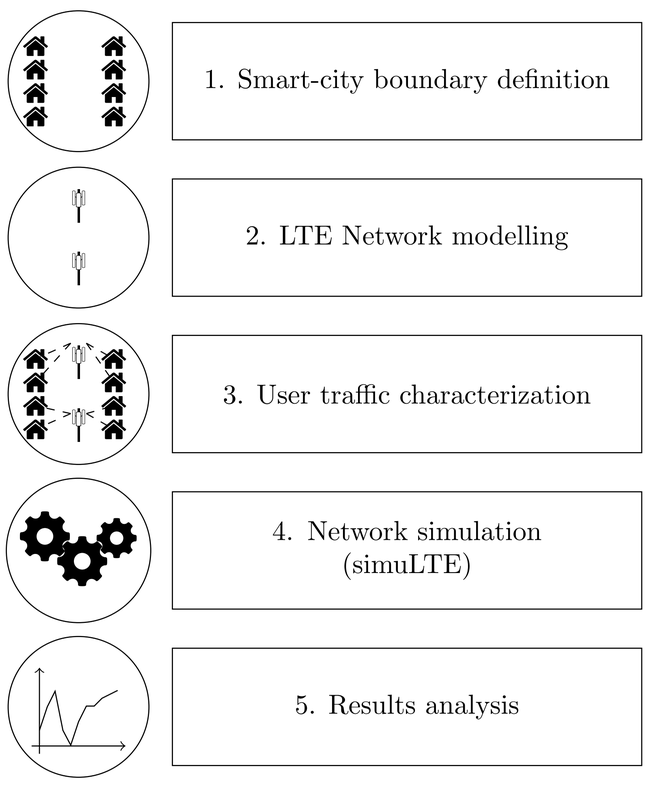
The massive introduction of traffic from the Internet of Things (IoT), particularly in smart-city scenarios, needs to be supported by a steady, pervasive and reliable communication infrastructure. Cellular networks (such as LTE and 5G) are considered a popular solution to support the increasing amount of traffic from the Internet of Things (IoT), especially in smart cities. However, a massive deployment of IoT devices in existing cellular infrastructures can jeopardize the communication of human users and the overall network performance. In this study, the coexistence of IoT traffic and human users in a smart-city LTE infrastructure was studied through simulation using the SimuLTE software. Real geographical data were employed on the position of LTE base stations and IoT devices, retrieved from publicly available sources. Key network indicators, such as user throughput and cell utilization, were adopted to analyze both network and user performance. Simulation results showed a considerable performance degradation when IoT traffic is introduced into the network.

Introduction

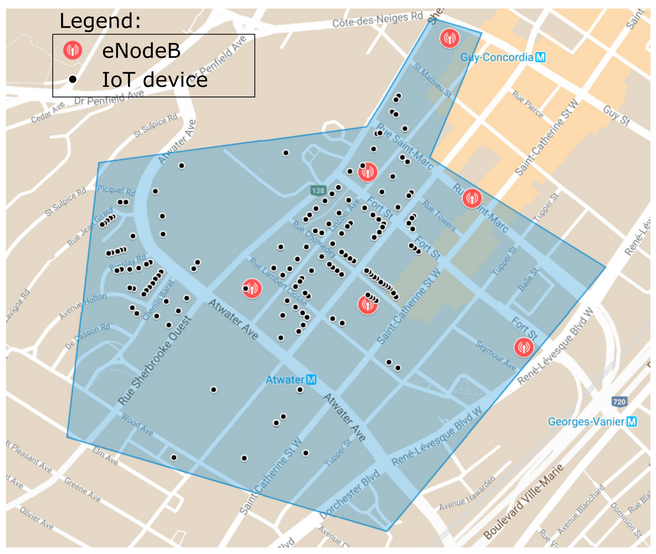
- Number of IoT devices **increasing** due to its benefits in various fields
- This growth needs a **reliable** infrastructure to support it
- **LTE** is a standard worldwide and a promising solution
- However, the massive introduction of IoT devices in **LTE** networks may **degrade** network performance

Objective: gain insight into the **coexistence** of human and IoT traffic in a smart-city

Methodology



Simulation Scenario



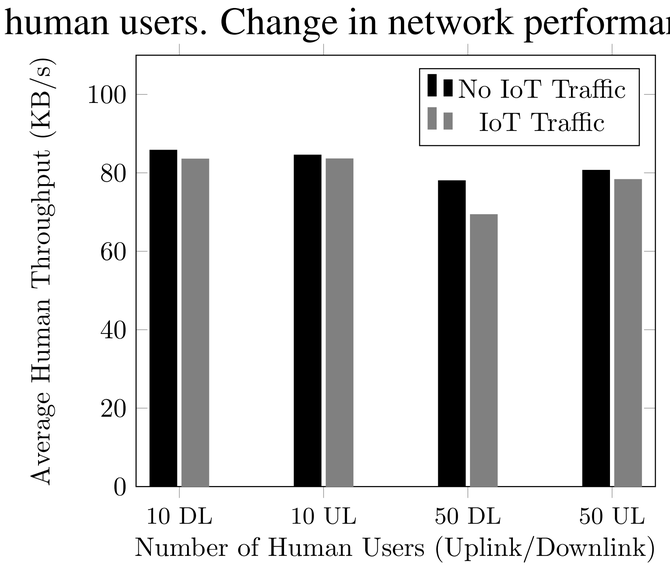
- **Real geographical data** from Montreal on house (black) and antenna (red) locations.
- A polygon of area $0.68\ km^2$ contains the topology
- Data on **150 IoT devices** was used for this simulation
- Antenna data is shown in the table below

Main physical parameters of eNodeBs/antennas

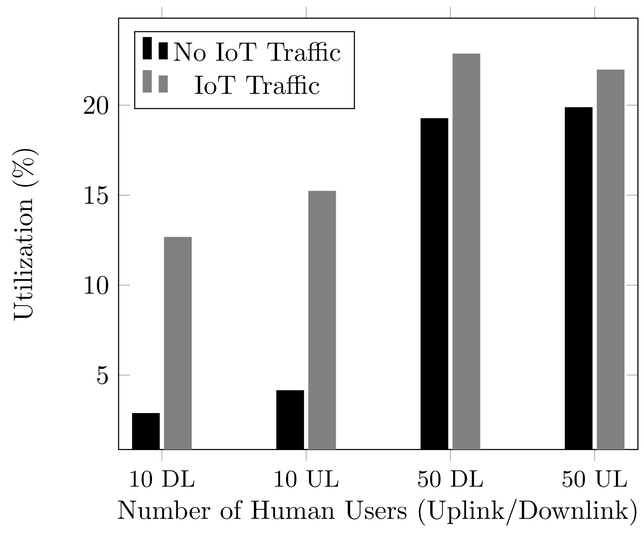
eNB	Antenna	Lat.(N), Long.(W)	Azimuth Angle ()	Downtilt Angle ()	ERP (W)	Frequency (MHz)	Bandwidth (MHz)
1	1	(45.4903 , -73.5794)	255	-8	73.311	2120	20
	1	(45.4911 , -73.5836)	50	-10	36.744	2120	20
2	2	(45.4911 , -73.5836)	170	-8	36.744	2120	20
	3	(45.4911 , -73.5836)	290	-7	36.744	2120	20
	1	(45.4914 , -73.5867)	100	-10	48.433	2120	20
3	2	(45.4914 , -73.5867)	200	-10	48.433	2120	20
	3	(45.4914 , -73.5867)	310	-6	48.433	2120	20
	1	(45.4931 , -73.5808)	70	-12	48.433	2120	20
4	2	(45.4931 , -73.5808)	180	-10	48.433	2120	20
	1	(45.4936 , -73.5836)	55	-10	48.433	2120	20
5	2	(45.4936 , -73.5836)	190	-9	48.433	2120	20
	3	(45.4936 , -73.5836)	290	-3	48.433	2120	20
	1	(45.4961 , -73.5814)	25	-9	36.744	2120	20
6	2	(45.4961 , -73.5814)	205	-6	36.744	2120	20
	3	(45.4961 , -73.5814)	290	-3	36.744	2120	20

Simulation Results

Analysis 1: IoT traffic is added to existing networks containing 10 and 50 human users. Change in network performance is monitored.

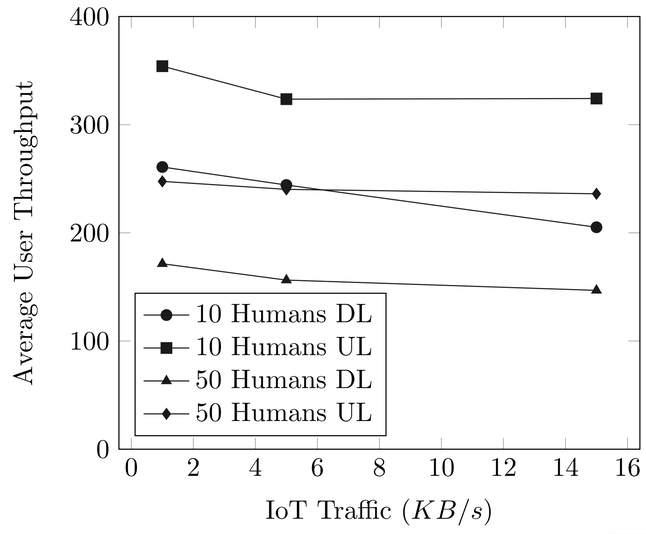


- **User throughput is reduced** by the introduction of IoT traffic

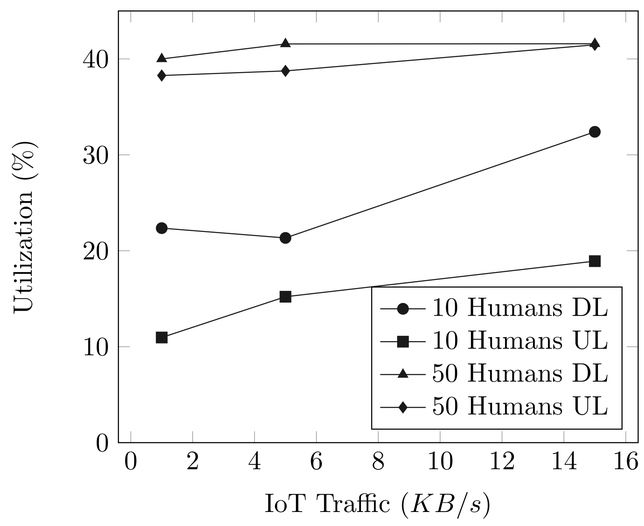


- **Average cell utilization is increased** by presence of IoT traffic

Analysis 2: With the network topology constant, **IoT packet size** was allowed to vary from 1 KB to 15 KB



- **User throughput decreases** from increased IoT packet size.



- **Average cell utilization increases** with increasing IoT traffic

Conclusions

- The **coexistence** of IoT devices and human users was studied through simulation using **real geographical data**
- Results show a reduced **user throughput** and increased **cell utilization** caused by congestion in the network from IoT traffic

Acknowledgements

The authors would like to thank Antonio Virdis, Assistant Professor at the University of Pisa, for his valuable help in the configuration of SimuLTE.