



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

itee^{PhD}
information technology
electrical engineering



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Idio Guarino

Traffic analysis of mobile communication and collaboration apps via ML approaches

Tutor: Antonio Pescapè

Cycle: XXXVI

Year: First

My background

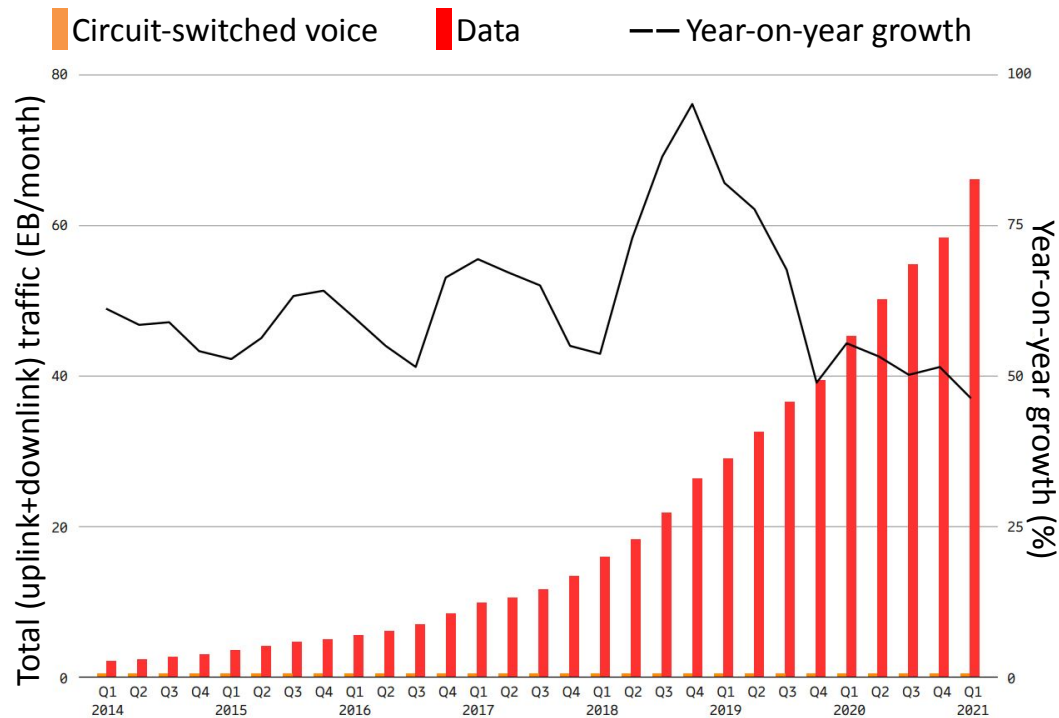
- MSc degree: Computer Engineering
- Research group/laboratory: Traffic Group/ARCLab
- PhD start date: 01/11/2020

- Scholarship type: no scholarship. Funded by Consortium GARR through the awarded "O.Carlini" research grant.



Mobile traffic growth

- Massive usage of smartphones and other portable devices has significantly changed the traffic both in terms of **volumes** and **services provided** (e.g. audio/video streaming, chat, audio/video call, etc.).



Ericsson Mobility Report | June 2021

Idio Guarino

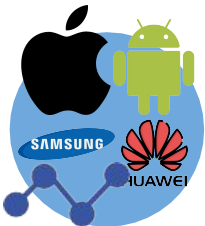
Research field of interest

- **Network operators** need to know the characteristics of the traffic flowing through their network.

Challenges



Many Apps



3rd-party Services Ambiguity

Traffic Heterogeneity (*user, device, OS*)

Dynamicity and continuous evolution



Cryptography ➡ hinders payload inspection methodologies

NAT/Dynamic Port Mapping ➡ hinders port-based methodologies

Summary of study activities

In order to deepen my knowledge on these topics I attended the following courses, seminars, and conferences:

- Courses:
 - Neural Networks and Deep Learning;
 - Big Data Analytics and Business Intelligence;
 - Scientific Programming and Visualization with Python;
 - Statistical data analysis for science and engineering research;
 - Data Science for Patient Records Analysis.
- 18 Seminars
- Conferences:
 - *2021 IEEE 6th International Forum on Research and Technology for Society and Industry (RTSI);*
 - *2021 IEEE International Workshop on Computer Aided Modeling and Design of Communication Links and Networks (CAMAD).*

Research activity: Overview

- Use of data-driven approaches aimed at:

- Traffic Classification (TC):

What's going through my (mobile) network?



- Traffic Prediction (TP):

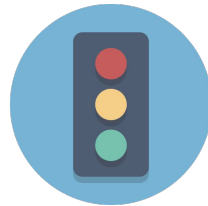
How will traffic characteristics evolve in time?



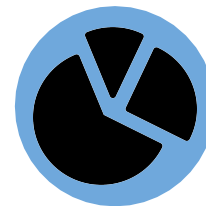
Application scenarios



Quality of
Service



Traffic
Engineering



Resource
Management





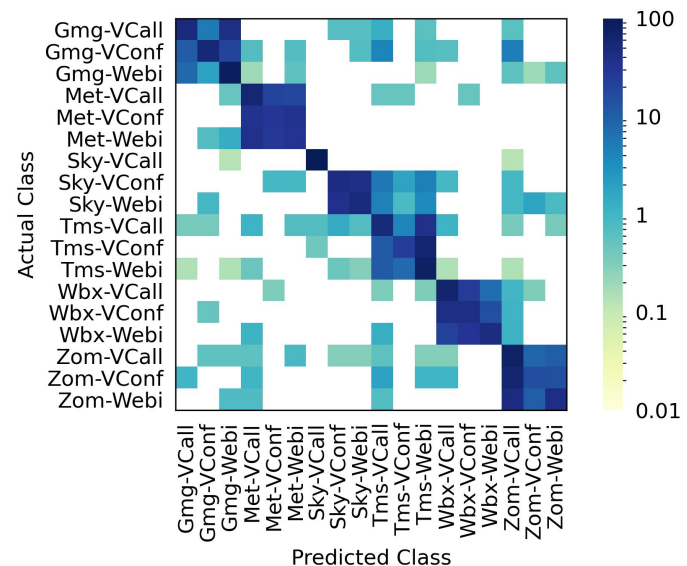
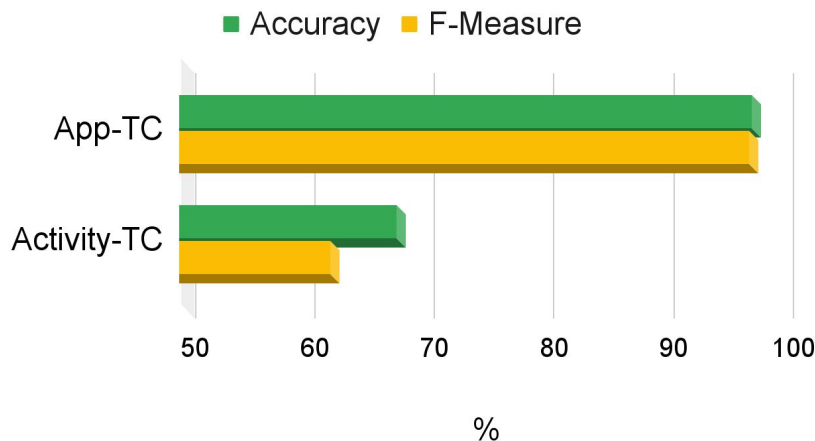
Security

Research activity: Overview

- **Collection** of a dataset
of real traffic generated by communication and collaboration apps (e.g. Zoom, Teams), which have experienced a recent surge in traffic due to the spread of the COVID-19 pandemic.
- **Traffic Characterization** (at different levels) and **Modeling** (via Markov Chains) [P1]
by taking into account both the apps and the activities performed by the user.
- **Traffic Prediction** [P2]
by means of Markov Chains using training strategies at different granularities.
- **Traffic Classification** [P3]
to address the classification of apps, activities, and both of them by means of state-of-the-art classifiers (DL-based).

Research activity: Initial Results

- The same app provides many services ➔ user can perform different activities (e.g. Chat, Audio/Video-Call, Webinar, Audio/Video live Streaming)
-  Apps are classified with near ideal performance
-  Classification of the performed activities by the user needs more sophisticated models



Products

[P1]	<i>Characterizing and Modeling Traffic of Communication and Collaboration Apps Bloomed With COVID-19 Outbreak</i> , Idio Guarino, Giuseppe Aceto, Domenico Ciunzo, Antonio Montieri, Valerio Persico, Antonio Pescapè, 2021 IEEE 6th International Forum on Research and Technology for Society and Industry (RTSI), published, 2021
[P2]	<i>Mobile Network Traffic Prediction Using High Order Markov Chains Trained at Multiple Granularity</i> , Idio Guarino, Alfredo Nascita, Giuseppe Aceto, Antonio Pescapè, 2021 IEEE 6th International Forum on Research and Technology for Society and Industry (RTSI), published, 2021
[P3]	<i>Classification of Communication and Collaboration Apps via Advanced Deep-Learning Approaches</i> , Idio Guarino, Giuseppe Aceto, Domenico Ciunzo, Antonio Montieri, Valerio Persico and Antonio Pescapè, 2021 IEEE International Workshop on Computer Aided Modeling and Design of Communication Links and Networks (CAMAD), accepted, 2021

Next Year

- Implementation and evaluation of novel approach to mobile TC and TP based on advanced learning strategies (e.g. multimodal and multitask) and DL layers (e.g., inception, residual, attention);
- Implementation and evaluation of a improved methodology for user activity classification.