



# Antonio Montieri

Tutor: Prof. Antonio Pescapè

XXXII Cycle - I year presentation

*Techniques for Mobile and Encrypted  
Traffic Classification*



UNIVERSITÀ DEGLI STUDI DI NAPOLI  
FEDERICO II

# Background

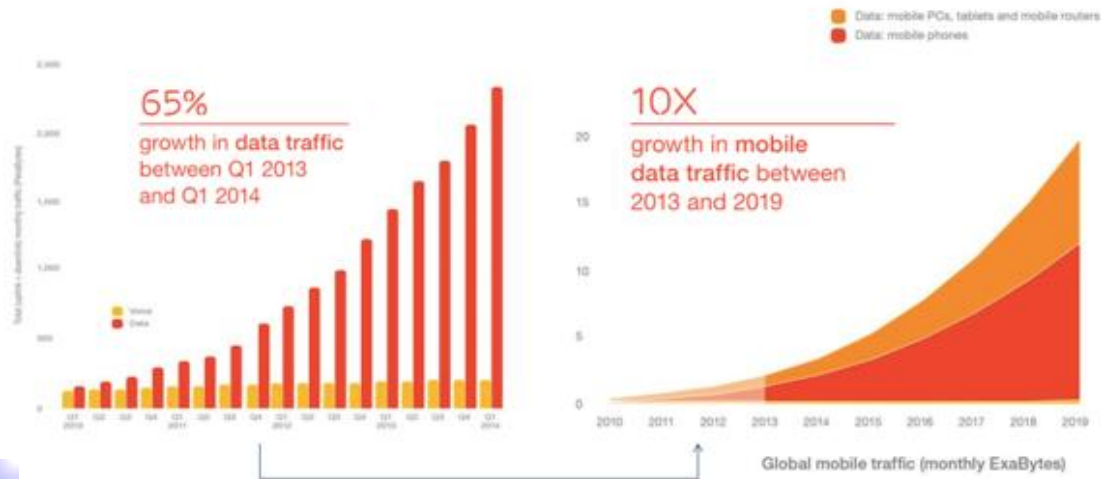
- **Graduation:** M.Sc. Degree in Computer Engineering, cum laude
- **DIETI Group:** Computer Networks *COMICS* research group
- **Cooperation:** Huawei Technologies Co., Ltd
- **Fellowship:** University Ph.D. grant



# Mobile Traffic Growth

- Massive usage of smartphones and other handheld devices has significantly changed the traffic
  - traversing home and enterprise networks
  - to/from contents and services over the Internet

## MOBILE TRAFFIC GROWTH



Ericsson Mobility Report June 2014 | © Ericsson AB 2014 | Page 7

*Ericsson Mobility Report: Global 4G/LTE divide will be wide in 2019.*

Antonio Montieri

# Mobile Traffic Analysis: Main Drivers

## Accurate Classification

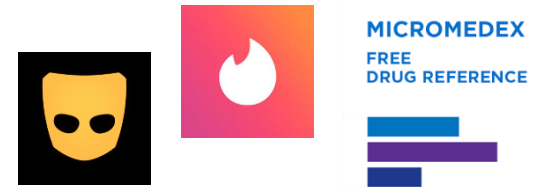
- **[+] provides valuable information**

- For advertisers
- For insurance companies
- For security agencies



- **[-] raises privacy issues**

- Health and dating apps
- Bring-your-own-device policy



# Mobile Traffic Classification (TC)



What is flowing through my (mobile) network?

*Need for associating flows (or other classification objects) with the mobile apps that generate them*



# Current Research Goal

Improving the **classification performance** on (encrypted) mobile apps traffic



- Evaluation of **state-of-the-art classification algorithms** and related features, selection of the most promising ones
- Proposal and evaluation of a **multi-classification approach** capitalizing the best classifiers and adopting state-of-the-art combining techniques

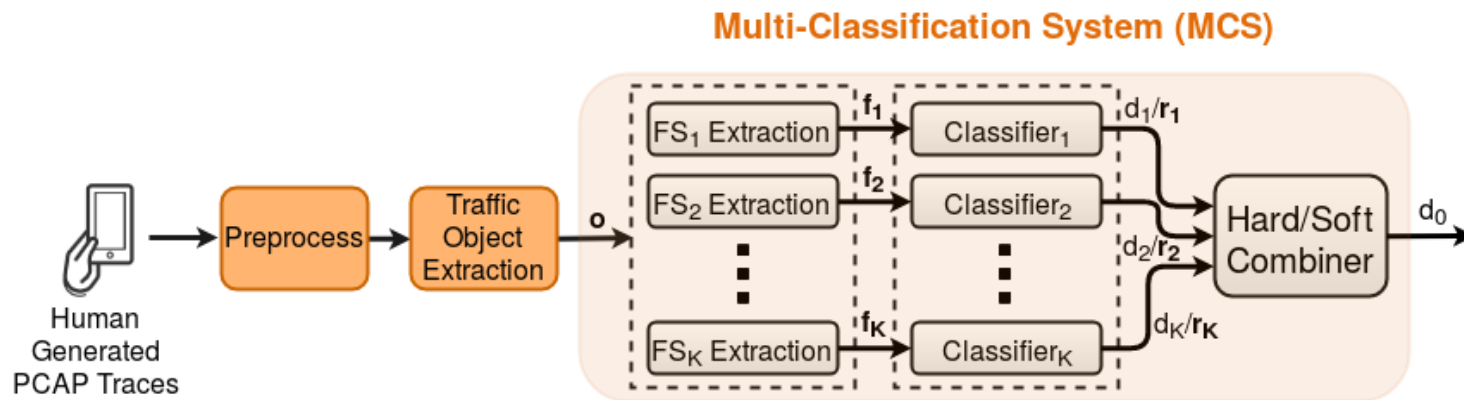


# How can we take the best from each state-of-the-art classifier?



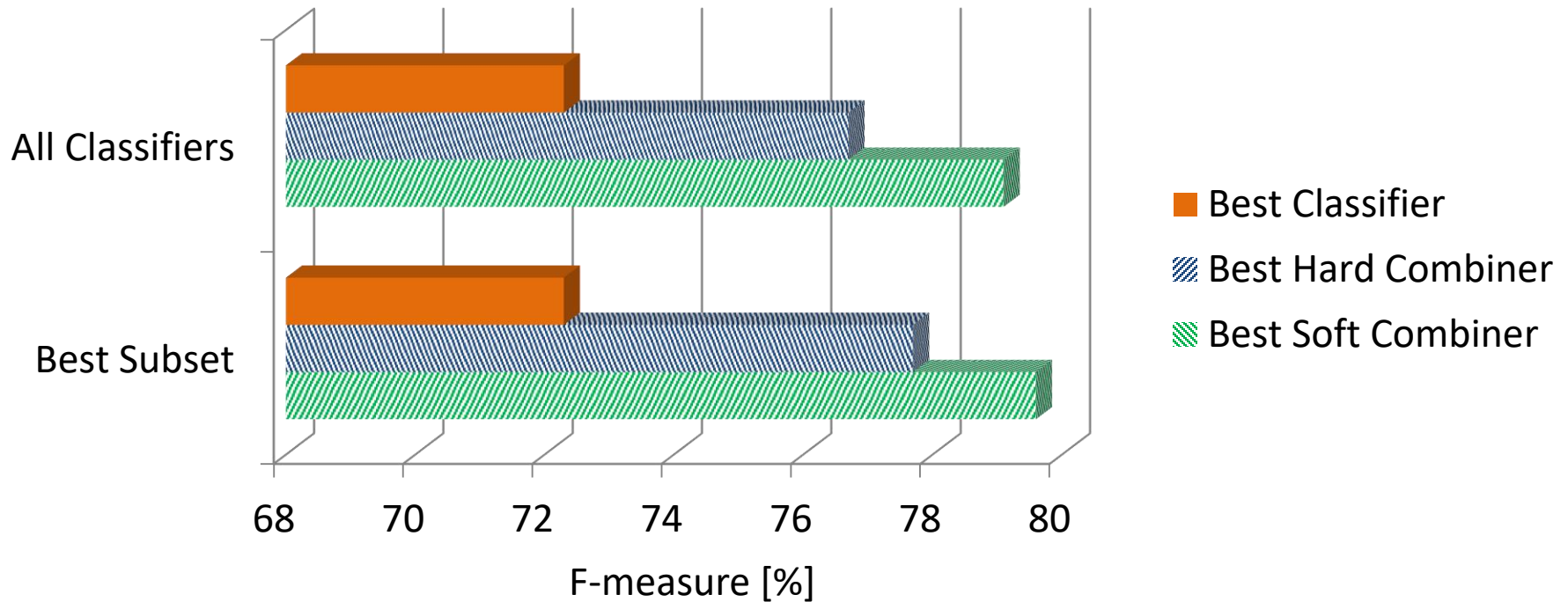
Outputs from state-of-the-art classifiers can be combined in order to perform **multi-classification** tasks

Various **classifier fusion rules** have been proposed in the literature [1, 2] based on both **hard** and **soft** approaches



[1] A. Dainotti, A. Pescapé, and C. Sansone, "Early classification of network traffic through multi-classification"  
[2] L. I. Kuncheva, "Combining pattern classifiers: methods and algorithms"

# Performance of Mobile TC: Some Results



Careful selection of combination rule and classifiers' subset allows to obtain up to **+7,1% increment** of F-measure



# Performance of Anonymous TC: Some Results



I2P



Tor (5283, a)	
Streaming (84, b), Torrent (84, c), Browsing (84, d)	
Flash proxy (172324, e), FTE (106237, f), Meek (43152, g), Obfs3 (14718, h), Scramble suit (16953, i)	
I2PSnark (127349, j), jIRCii (29357, k), Eepsites (38375, l)	
I2PSnark (149992, m), jIRCii (149998, n), Eepsites (149997, o)	
I2PSnark (62, p), jIRCii (221, q), Eepsites (145, r), Exploratory Tunnels (86, s), Participating Tunnels (126, t)	
JonDonym (6335, u)	



Associating **traffic flows** with the specific **anonymity tool** generating them

# Publications

- ***Journal Papers***

- Giuseppe Aceto, Domenico Ciuonzo, **Antonio Montieri**, Antonio Pescapè, *Multi-Classification Approaches for Classifying Mobile App Traffic*, Elsevier Journal of Network and Computer Applications, vol. 103, pp. 131–145.
- **[Accepted]** **Antonio Montieri**, Domenico Ciuonzo, Giuseppe Aceto, Antonio Pescapè, *Anonymity Services Tor, I2P and JonDonym: Classifying in the Dark (Web)*, IEEE Transactions on Dependable and Secure Computing.

- ***Conference Papers***

- Giuseppe Aceto, **Antonio Montieri**, Antonio Pescapè, *Internet Censorship in Italy: an Analysis of 3G/4G Networks*, 2017 IEEE International Conference on Communications (ICC 2017); Communication QoS, Reliability and Modeling (CQRM) Symposium, May 21-25, 2017, Paris, France.
- **Antonio Montieri**, Domenico Ciuonzo, Giuseppe Aceto, Antonio Pescapè, *Anonymity Services Tor, I2P, JonDonym: Classifying in the Dark*, 29th International Teletraffic Congress (ITC 29), September 4-8, 2017, Genova, Italy.
- Giuseppe Aceto, Domenico Ciuonzo, **Antonio Montieri**, Antonio Pescapè, *Traffic Classification of Mobile Apps through Multi-classification*, 2017 IEEE Global Communications Conference (IEEE GLOBECOM 2017); Communication QoS, Reliability and Modeling (CQRM) Symposium, December 4-8, 2017, Singapore.

# Next Years

- First year report and next year estimation

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Cycle XXXII

	Credits year 1								Credits year 2								Credits year 3								Total	Check
	Estimated	1	2	3	4	5	6	Summary	Estimated	1	2	3	4	5	6	Summary	Estimated	1	2	3	4	5	6	Summary		
Modules	20	4	3	0	6	4	6	23	10							0								0	23	30-70
Seminars	10	4,9	1,8	2	0,5	0,3	0,3	9,8	5							0								0	9,8	10-30
Research	30	1,1	5,2	8	3,5	5,7	6,7	30,2	45							0								0	30,2	80-140
	60	10	10	10	10	10	13	63	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63	180

- Research directions for next year
  - Novel approaches to mobile TC (e.g., Deep Learning, hierarchical approaches)
  - Other application fields (e.g., IoT device traffic)



# Thank you!



## Questions?

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