SIGNAL PROCESSING FOR ANONYMOUS COMMUNICATIONS

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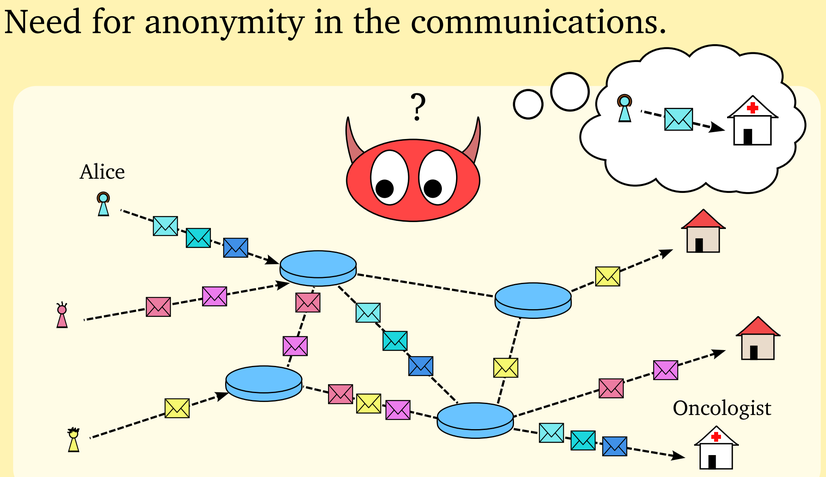
MOTIVATION OF THE WORK

Need for anonymity in the communications.



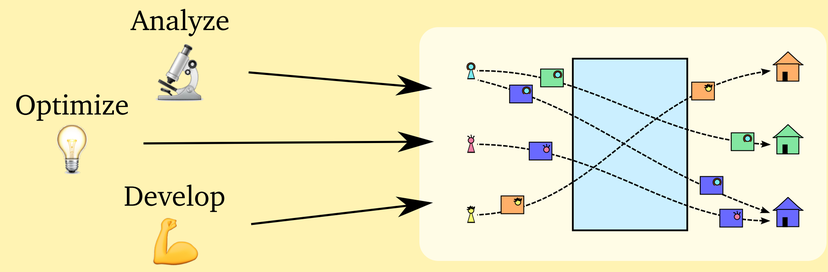
Current Analyses: Idea!! Signal Processing!

- Simplify the problem with unrealistic hypotheses. → Applicable to very complex problems (digital communications, forensics, etc).
- Rely on very complex mathematical devices. → Simplifies the problem.
- Provide only empirical results. → Provides analytical results.

THESIS OBJECTIVES

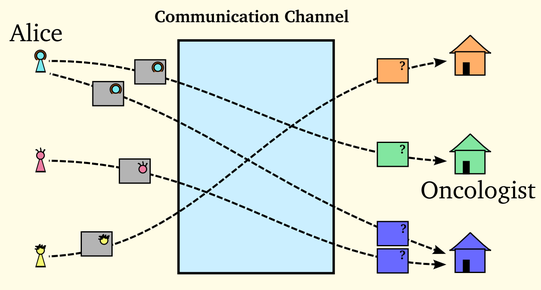
General objective

Apply signal processing tools to anonymous communications.



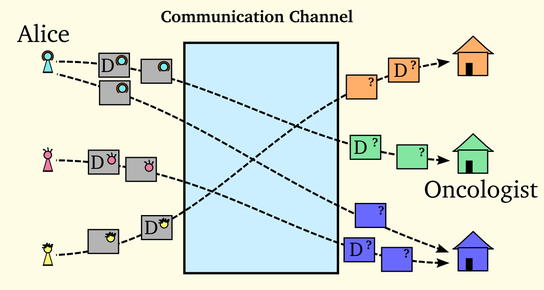
We will study two scenarios:

High-latency communication systems [1][2] (e.g., email).



- Delaying messages is allowed!!
- Robust against global adversaries.

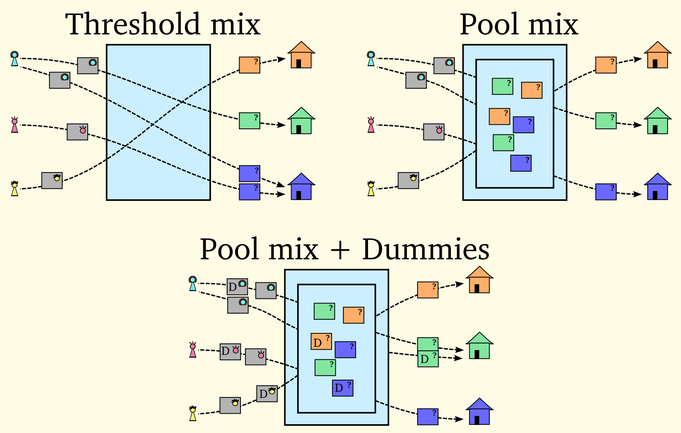
Low-latency communication systems [3][4] (e.g., instant messaging, VoIP, browsing).



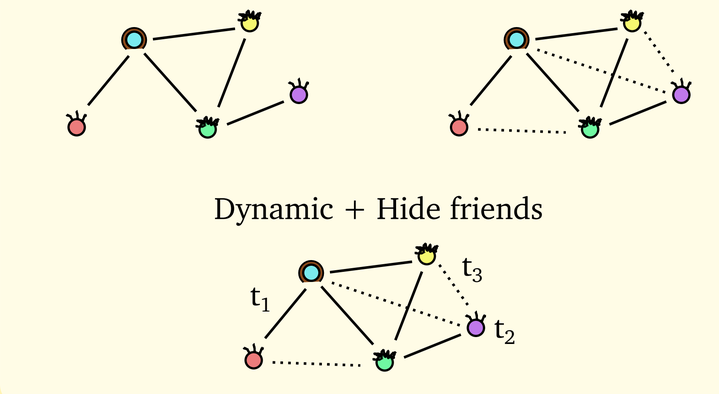
- Delaying messages is NOT allowed!!
- Explore other posibilities: dummy messages, re-routing...

RESEARCH PLAN

6 m.
- Study the state of the art.
- High latency anonymous communications:



17 m.
- Low latency anonymous communications:



11 m.

Methodology
1. Develop theoretical models.
2. Apply signal processing tools to analyze the privacy properties.
3. Optimize the privacy mechanisms.
4. Propose new protection mechanisms.
5. Empirical evaluation of our findings.

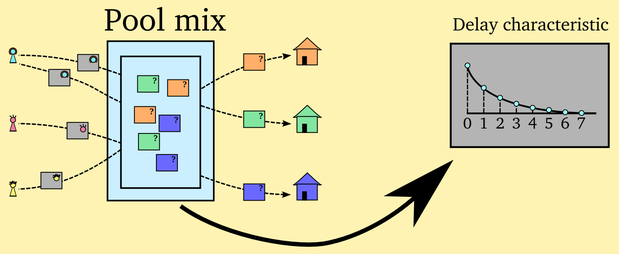
2 m.
- Wrapping up, conclusions and writing.

PREVIOUS RESULTS

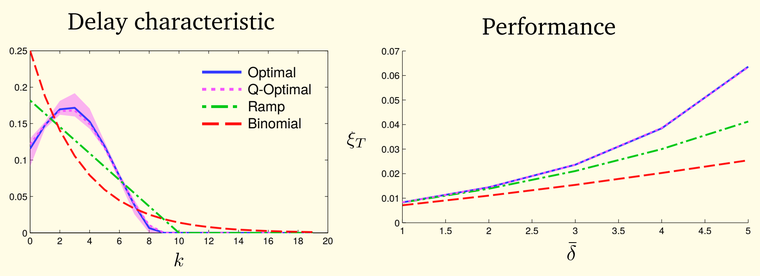
- Related work: new attack on mixes, the Least Squares Disclosure Attack (LSDA) [5].
- Proof that LSDA outperforms the family of statistical disclosure attacks [7].
- Analysis of a pool mix with dummies [8].
- In-depth study of LSDA on pool mixes [9].
- Analysis of the mix in real scenarios [10].

NEW RESULTS

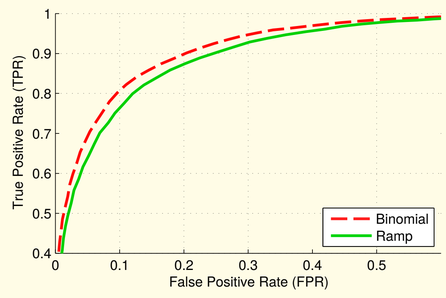
- Analysis of the pool mix in real scenarios. Optimal delay function for the pool mix [11].



Results with real data:



Performance under a traffic analysis attack [6].

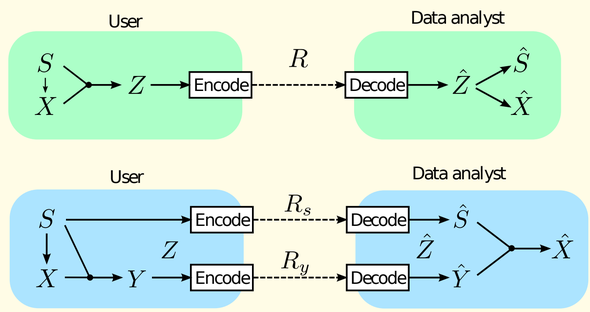


Analogy with a filter design problem.

→ Continue in future work?

- Privacy-Bandwidth-Utility trade-offs. Can we use bandwidth to provide privacy?

Started in **Rutgers University** (NJ) with Professor Anand Sarwate.



NEXT YEAR PLANNING

- Continue the work started in Rutgers University: can we use extra bandiwdth to provide privacy whithout worsening performance?
- Connect this work with mixes (mixes can be seen as devices that perform time quantization).
- Delve into the delay characteristic design problem as a filter design problem.

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[11] **S. Oya**, F. Pérez-González, and C. Troncoso, "Design of Pool Mixes Against Profiling Attacks in Real Conditions", IEEE /ACM Transactions on Networking, 2016.