SWINBURNE UNIVERSITY OF TECHNOLOGY

Identification of Generic Attributes of Skype Traffic with Machine Learning

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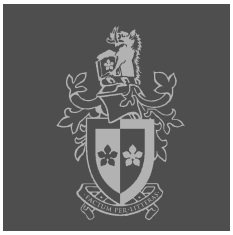


Project Outline

- Statistical Identification of different versions of Skype.
- Identification of Games, Gtalk and Skype
- Identify traffic characteristics so that it will not change from one version to the next
- Identification done by extracting features (attributes) and using machine learning

Why Classify Traffic ?

- Lawful Interception of Traffic
- Identify types of encrypted traffic
  - Skype
    - Restrict access
    - Lawful interception
    - Cisco NBAR can only detect Skype version 1
  - Games
    - Quality of Service
    - The ANGEL project at CAIA- Identify interactive traffic to provide better performance

Why Classify Traffic?

- Classification used in market research
  - Research on who is using what...
  - Research to better understand what applications people are using on the internet
- Quality of Service
  - ISP's want to provision for traffic to minimise delays or increase efficiency

Methods to Classify Traffic

- Well known port numbers
  - But now we use higher port numbers
- Deep Packet Inspection
  - Computationally intensive
  - Does not work well with encrypted traffic like Skype
- Traffic Characteristics
  - How traffic varies with different features
  - Finding features to separately classify traffic

Previous Work at CAIA

- Identification of Skype Traffic using machine learning[1]
- Identification of Bit Torrent Traffic using machine learning[2]
- Identifying characteristics of games traffic
- Faster identification of traffic using sub flow characteristics[3]

1. Philip Branch,Amiel Heyde Grenville J Armitage, Rapid Identification of Traffic Flows, *ACM NOSSDAV 2009*, Williamsburg, Virginia, USA, 3-5 June 2009
2. Philip Branch , Jason But, Tung Le, Rapid Identification of BitTorrent Traffic, 35th Annual IEEE Conference on Local Computer Networks (LCN 2010), Denver, Colorado, USA, 11-14 October 2010
3. Nguyen, T., Armitage, G. 2006 Training on multiple subflows to optimise the use of Machine Learning classifiers in real-world IP networks in IEEE 31st Conference on Local Computer Networks, pp. 369-376. Tampa, Florida, USA

Previous Work at CAIA

- Work done previously relies mainly on packet lengths
  - But this characteristic usually changes from one version to another version
  - For Games it changes with the number of players
- Classification with Machine Learning
  - Classification with full flow and partial flows
  - Partial flows are quicker- especially for real time traffic

Skype

- We examined Skype versions 2,3 and 4
- Skype is a peer-to-peer VOIP application
- Skype can negotiate dynamic ports and it uses encrypted traffic
- The features across all versions differ
  - This is due to Skype using different codec's with each version
- We wanted to find a generic Skype classifier

Games

- Games characteristics change with increasing number of players
- From Previous work done at CAIA
  - Mean of Games Traffic increases linearly with increasing players
  - Variance of Games increases linearly with increasing players

Features

Features are statistical characteristics that can be used to identify different types of traffic.

- Mean Packet Payload
- Variance of Payload
- Ratio of Payload for Forward and Reverse Flows
- Inter-arrival time
- Index of Dispersion
- Two Packet Difference
- Absolute Two Packet Difference

Machine Learning

- A way to classify a given set of data using computer algorithms
  - Use the features that can differentiate each type of traffic to train the classifier.
  - After training it is tested against another set of data.
- Training
  - Train Skype V3 and “Other”
  - Training all Skype versions, Gtalk, Games and “Other”
- Testing
  - Test with Skype 4 and “Other”
  - Include Games into Other

Machine Learning

Two classification algorithms used

- J48 classifier- Uses a decision tree and is a supervised learning classifier
- Naïve Bayes – A probabilistic classifier which is used for supervised learning
- We discovered that the J48 classifier performed better with differentiating between traffic types.

Tools

- Tcpdump- Capture traffic flows
- WEKA – classify traffic types
- Scripts – written by Dr.Jason But
  - Calculation of Features for sub flows, from a given pcap file.
  - Plotting CDF of Features
  - Converting .CSV to a .arff file(.arff in the WEKA input file with selected features)

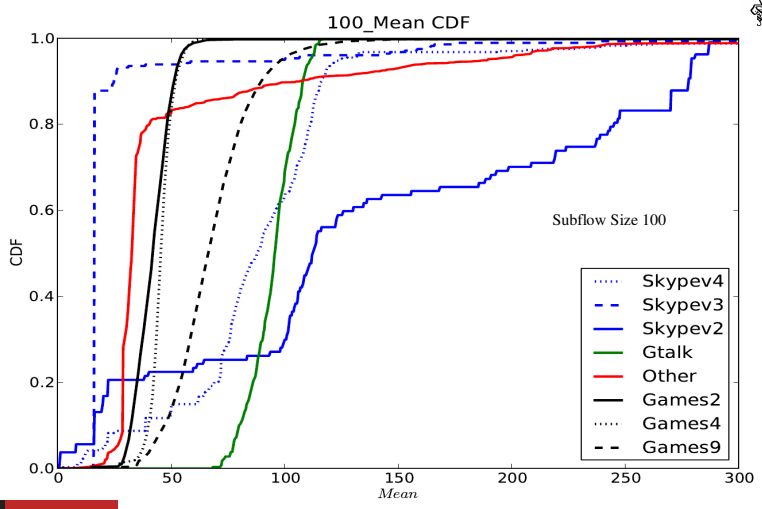
Identification of Features

- The statistical characteristics calculated for the bidirectional, forward and reverse direction for each sub flow.
- Sub flows sized from 100 to 800 packets
- The CDF was plotted for all of the features for each traffic type.
- Features that were chosen
  - Mean, Two Packet Difference, Absolute Two Packet Difference, Index of Dispersion and Inter-arrival time.

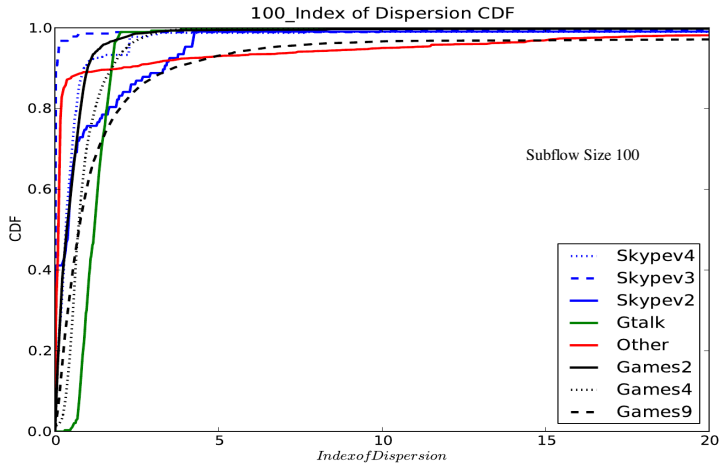
Train on Skype V3 Test on Skype V4

- Skype Classification
  - Identify Skype version 4 traffic when trained by Skype version 3
- WEKA is given the Skype v3 and Other traffic
- Tested on Skype v4 for each combination of selected features
- Attributes that were successful in classifying
  - Mean, Index of Dispersion, Inter-arrival time and Two Packet Difference

Mean

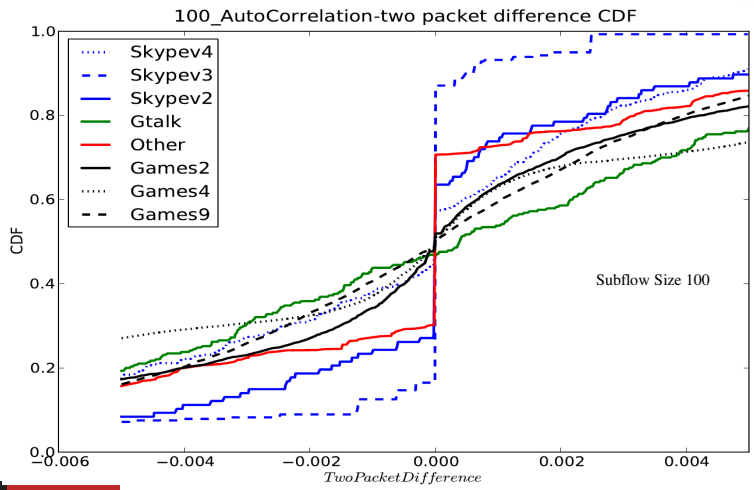


Index of Dispersion

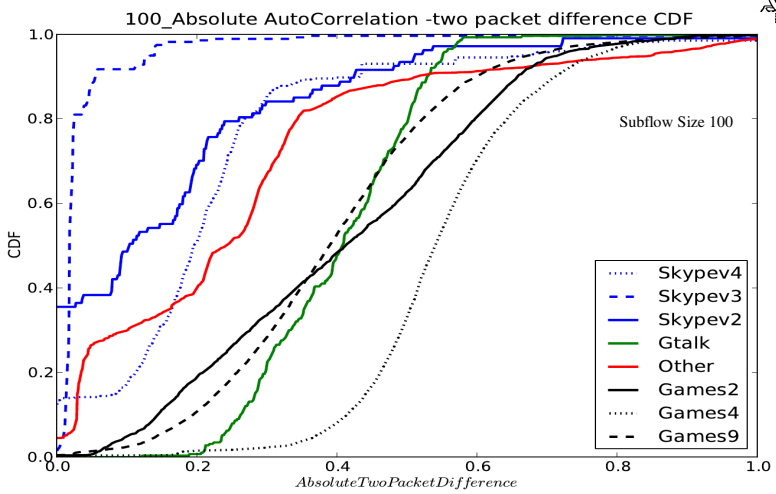


$$D = \frac{\sigma^2}{\mu}.$$

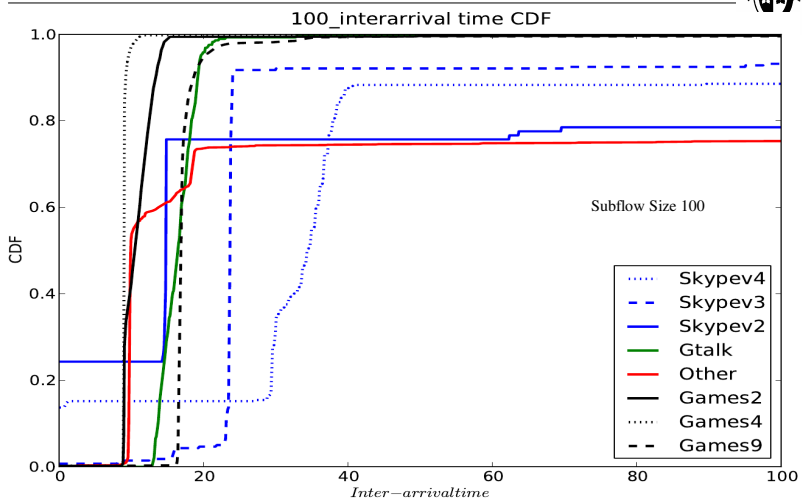
Two Packet Difference



Absolute Two Packet Difference



Inter-Arrival Time



Results

- Results shown are for classifying Skype for a sub-flow size of 100
- Results were obtained using J48 classifier

Precision	Recall	Class
0.974	0.858	Skype
0.979	0.996	Other

=== Confusion Matrix ===

a b <-- classified as

484 80 | a = Skype

13 3665 | b= Other

Conclusion

- Given the time frame, we were only able to train Skype,Games & Gtalk for certain attributes
- Training suggests that Skype and Games can be classified successfully
- Harder to classify Gtalk and Games
- Future work possible to create a more generic classifier

Acknowledgments

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