Traffic analysis in the TRAMMS project

Aurelius, Andreas; Lagerstedt, Christina; Kihl, Maria; Perenyi, Marcell; Sedano, Inigo; Mata, Felipe

2009

Traffic analysis in the TRAMMS project

Andreas Aurelius[1], Christina Lagerstedt[1], Maria Kihl[2], Marcell Perényi[3], Iñigo Sedano[4], Felipe Mata[5]
[1] Acreo AB, Kista, Sweden
[2] Dept. of Electrical and Information Technology, Lund University, Sweden
[3] Budapest University of Technology and Economics, Budapest, Hungary
[4] Robotiker Tecnalia, Bilbao, Spain
[5] Universidad Autonoma de Madrid, Madrid, Spain

***Abstract*—This is the abstract.**
Contact information –
Andreas Aurelius
Netlab
Acreo AB
Electrum 236
164 40 Kista
Sweden
telephone: +46 8 632 78 02
email: andreas.aurelius@acreo.se

I. Introduction

The Internet as we know it today, is a network of networks that has continuously evolved over the years as an effect of rapid innovation and development. This innovation and development is driven by various actors with varying agendas. These agendas can be commercial, political, social, developmental, etc, and with the support of a rapid technology development, new services and new ways of communicating emerge. Due to this complexity in the driving forces and the complexity in the underlying technologies that make up the backbone of the Internet, it is increasingly important to monitor and analyze the traffic in the networks and to stay up date with trends and paradigm shifts.

The main goal of the TRAMMS project is to provide data and analysis for the above mentioned purposes. In short the project measures and analyzes IP traffic in various access networks. The analysis strives to address issues like:

- user behavior
- user characterization
- trend analysis
- bottleneck analysis

-

this is a citation [1],

II. About TRAMMS

The Celtic TRAMMS project (Traffic Measurements and Models in Multi-Service Networks) [2], is a three year project with partners from Sweden, Spain and Hungary:

- Acreo AB, Sweden
- BUTE -Budapest University of Technology & Economics, Hungary
- Ericsson AB, Sweden
- Euskaltel, Spain
- GCM Communications, Spain
- Lund University, Sweden
- Procera networks, Sweden
- Fundación Robotiker, Spain
- Telefónica I+D, Spain
- Telnet-RI, Spain
- Universidad Autónoma de Madrid, Spain

The main objective of TRAMMS is to model traffic in multi-service IP networks, and to use the models as input for capacity planning of tomorrow's networks. The models will be built upon data acquired with advanced traffic measurements on the application level with deep packet/ deep flow inspection in different parts of Europe, combined with bottleneck analysis and interdomain routing analysis.

Parameters such as applications used, trends in application usage, penetration of applications, peak hours, peak rates, traffic volume, uplink/downlink ratios, network traffic locality, service specific user behaviour are analysed at different time scales, and typical user types are defined. The influence on the user behaviour from different first mile technologies is studied as well as the difference in user behaviour between different regions in Europe.

this is italic text

III. Traffic measurements

A large focus of the project and a particular strength is the direct access to measurements in live networks. Traffic measurements in the following fixed metro/access and wireless access networks are performed within the project:

- The first Swedish municipal network is an open fibre based network with approximately 2600 FTTH and 200 DSL customers. The FTTH customers represent many social and ethnic groups, while the DSL customers constitute a more homogeneous group of Swedish middle class living in single family houses.
- The second Swedish municipal network is a FTTH network with 350 IPTV users. This was used only to study user IPTV behavior.
- The commercial Spanish network contains both fixed and wireless access networks. The wireline part consists of a fibre network to the cabinet (FTTC) and the last mile consists of Cable Modem Termination System (CMTS) and ADSL. The wireless access is a combined GPRS and UMTS system.
- The Spanish university network RedIRIS interconnects and allows Internet access to more than 300 institutions

with 2.7 million users. The network is SDH-based with link speeds from 2.5 Gbps up to 10 Gbps.

The measurement equipment is installed near the end-users, in order to ensure a high level of detail for the analysis.

A. Measurement tools

The measurements in the residential networks have been performed using PacketLogic (PL) [1], a commercial real-time hardware/software solution used mainly for traffic surveillance, traffic shaping or as a firewall. Traffic is identified based on packet content (deep packet inspection and deep flow inspection) instead of port definitions. PL uses the self-developed Datastream Recognition Definition Language (DRDL) [3] to identify different application protocols. The PL can identify more than 700 application protocols.

The measurements in the RedIRIS network have been performed with Cisco NetFlow [4]. NetFlow is a proprietary network protocol developed by Cisco Systems to run on their routers and implemented by other vendors as well. This protocol is used to monitor the traffic that traverses a router and to keep statistics of the performance by sampling some of the packets. Cisco defines a flow as a unidirectional sequence of packets sharing all the following 7 values, commonly referred as 7-tuple: Source and Destination IP addresses, IP protocol, Source and Destination ports (in case that the IP protocol is TCP or UDP), Ingress interface and IP Type of Service.

IV. Traffic analysis

The results in this paper are taken from the TRAMMS public deliverable D3.2, available at [2].

A. Daily profiles

An overview of the normalized average daily profiles in the networks is shown in Figure

The figure show that the Spanish fixed network and the Swedish network, despite using different access technologies (CMTS, DSL, FTTH) have similar daily traffic patterns, downlink traffic (this is also true for the uplink traffic). However, the RedIRIS academic network shows a very different daily traffic pattern for the downlink traffic. The amount of downlink traffic is less constant in the RedIRIS network than in the other networks (10% of the maximum traffic at 5 a.m.) and from 1 p.m. to 9 p.m. it decreases while it increases in the other networks. The main conclusion is that the shape of the daily traffic patterns depends on the subscriber type of the network (residential, enterprise, academic) and that there is a common daily traffic pattern for the networks that have mainly residential users.

B. Comparison of applications usage in different networks and technologies

In order to avoid the differences in the amount of unrecognized traffic between the Swedish network no.1 and the Spanish network only the traffic from the following application groups has been considered for this comparison: web browsing, P2P file sharing and multimedia streaming. In all the networks and technologies most of the traffic belongs to one of these groups.

As far as the uplink traffic is concerned, in the fixed networks (FTTH, DSL and CMTS) the P2P file sharing is responsible of more than 97% of the considered traffic regardless of the technology. In the case of the downlink traffic, in the fixed networks (FTTH, DSL and CMTS) the P2P file sharing generates an important amount of traffic depending on the technology (from 66% to 88%). Approximately 60% of the rest of the traffic corresponds to web browsing and 40% to multimedia streaming. Regarding the mobile network (GGSN) the amount of web browsing traffic is five times higher than the multimedia streaming. Compared to the fixed networks, the P2P file sharing traffic in the mobile network is lower in uplink (77% of the considered traffic) and much lower in downlink (27% of the considered traffic). In downlink the mobile network traffic belongs mainly to web browsing (61% of the traffic).

Downlink (%)

	Sw network 1		**Sp network**	
App group	**FTTH**	**DSL**	**CMTS**	**GGSN**
Web browsing	7.06	20.6	12.1	60.5
P2P file sharing	88.3	66.0	80.8	26.6
Multimedia streaming	4.7	13.4	7.0	13.0

Table I
VOLUME SHARE OF APPLICATION GROUPS IN THE DIFFERENT NETWORKS

Uplink (%)

	Sw network 1		**Sp network**	
App group	**FTTH**	**DSL**	**CMTS**	**GGSN**
Web browsing	0.4	2.6	1.9	20.7
P2P file sharing	99.4	96.7	97.0	76.5
Multimedia streaming	0.2	0.6	1.2	2.8

Table II
VOLUME SHARE OF APPLICATION GROUPS IN THE DIFFERENT NETWORKS

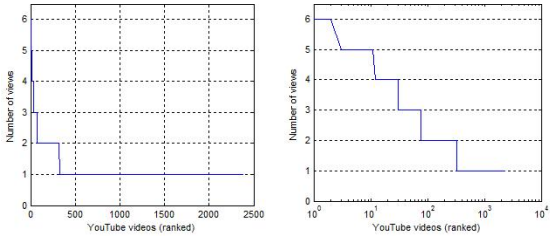
C. Content locality

Network traffic locality has been studied using measurements in the RedIRIS network. Traffic sent to and received from six universities within the RedIRIS network has been analyzed. The mapping of IP addresses with the related countries made use of the public free database for IP addresses' geographic localization of MaxMind which has an accuracy of 99.5%.

The majority of the packets are sent and received within Spain (around 40%). This is reasonable since all of the universities included in the study are located in Spain. In second place we found the United States (20% of the traffic). As the United States carries most of the researching developments and is the world leader in the information society, it is understandable when looking for first hand information to search within United States sites. Moreover, the majority of the most visited web pages are hosted in the United States. We find that nearly all countries are present in the study. Although their percentages of the traffic alone are very small (less than 10^{-3}% of the traffic) jointly they account for nearly 5% of the traffic.

D. Youtube content popularity

YouTube, on its own, produced about 2% of the total traffic and 15% of web traffic. The YouTube content popularity analysis also exposed several interesting findings. We regarded the "number of viewed videos per hour" a good estimation of the user activity and the traffic intensity as well. The user activity seems more intense on weekdays and lower on the weekend. Apparently, the user activity is higher in the afternoon and evening hours. The rank curve indicates that the popularity of the contents is not even; a limited number of videos are extremely popular, while others are watched rarely.



(a) (b)

Figure 1.

V. Conclusions

In conclusion, results from the TRAMMS project have been presented. It can be noted that bla bla bla....

VI. Acknowledgements

The work has partly been financed by the CELTIC project TRAMMS, with the Swedish Governmental Agency for Innovation Systems (VINNOVA) supporting the Swedish contribution. Maria Kihl is financed in the VINNMER programme at VINNOVA.

References

[1] "Procera networks." http://www.proceranetworks.com.
[2] "Traffic measurements and models in multi-service networks." http://projects.celtic-initiative.org/tramms/.
[3] "Packetlogic drdl signatures and properties 10340 (beta)," tech. rep., 2007.
[4] "Cisco netflow." http://www.cisco.com/go/netflow.