mPlane

an Intelligent Measurement Plane for Future Network and Application Management

ICT FP7-318627

Workshop Report with Anthology of Published Articles and Proposed Patents Associated with the Project

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Abstract:

This deliverable reports the record of the final mPlane workshop held in Heidelberg, Germany. This deliverables also reports the final antology of articles and the patent proposals published within the project.

Keywords: dissemination, publications, standardization, exploitation, open-source software

Disclaimer

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Contents

Document change record

Version	Date	Editor(s)	Description
0.1	18 Dec 2015	M. Ahmed (NEC)	initial draft
0.2	31 Dec 2015	M. Ahmed (NEC)	Final

1   Final Workshop

The mPlane final workshop was held by in conjunction with CoNEXT 2015, in Heidelberg Germany, organized by NEC. The workshop was well attended and reviewed by participants. Over 30 participants attended and three invited talks from distinguished researchers in the field were presented, and demos were given by all the mPlane participants.

The scope of the workshop was to illuminate the current and obscure dynamics of the Internet, mPlane Project has focused on building the Internet measurement plane, by designing a flexible, open platform that allows one to collect, store and process measurements collected from the Internet.

The workshop presented mPlane's achievements towards this goal. In addition to full presentations about mPlane reference architecture (featuring an open source implementation), components and the use cases that it enables, the workshop featured talks of measurement experts who will speak about topics related to the main concepts of building an Internet measurement plane.

The workshop program is summarized below, and more details and copies of the presentations given can be found at:
`http://www.ict-mplane.eu/public/mplane-workshop-platform-measuring-internet`

9:15am Welcome - [S. Niccolini, Technical Coordinator]
Session 1 - Architectures - Chair Saverio Niccolini
9:20am Overview of the mPlane project [M. Mellia, project coordinator]
9:45am mPlane architecture and principles (inlcuding reference open implementation) [B. Trammell, leader of mPlane architecture work package]
10:15am **Keynote by Balachander Krishnamurthy, AT&T Labs - Research** *"Is measurement still an afterthought?"*
Abstract: In the early days of ARPAnet it was possible to trace passage of a single packet through the network. Traffic between nodes could be directly measured and routers could be queried for current statistics. But only in the late 1980s were SNMP and traceroute created (and are still in use!). With fragmentation and decentralization, measurement became effectively a second-class citizen. Thus, architectural innovations come without measurement as a fundamental concept requiring reinvention of tools and techniques. Most of the work is now guided by needs of applications. I believe that we should identify measurement primitives that can aid in quicker construction of relevant tools in new application areas or novel architectures. This talk is aimed at pushing the community towards such a search using one application area as exemplar: SDN.

11:20am mPlane live demo [F. Invernizzi, leader of mPlane deployment work package]
11:45am **Keynote by Fabián E. Bustamante, Northwestern University** *"Content distribution on next generation cellular networks"*
Abstract: Smartdevices are becoming the primary, and for many only, Internet point of access for an ever-larger fraction of users. Nearly a quarter of web traffic is mobile, and content consumption on mobile devices is expected to grow fourfold by 2018. Much of this content is served by content delivery networks (CDNs) that, as in the rest of the Internet, replicate content in servers around the world and redirect clients to nearby replicas. Replica selection is typically done following some well-established heuristic, such as client IP or the proximity between most hosts and their local DNS servers. Unlike in the rest of the Internet, however, these heuristics are generally ineffective,

with their ineffectiveness becoming obvious in fast, next generation cellular networks. In this talk, I will discuss our work on understanding next generation cellular network infrastructure and configuration and evaluating its impact on content distribution and users's quality of experience. I will then sketch a new approach to replica selection that acknowledges the centrality of cellular gateways in cellular network routing and present early results from a realization of this approach as a client/CDN cooperation, i.e. without the cooperation of cellular operators.

Session 2 - Applications and Demos - Chair Marco Mellia
1:30pm mPlane components: probes [Á. Bakay, leader of mPlane work package on programmable probes]
2:00pm mPlane components: repositories [P. Michiardi, leader of mPlane work package on large scale data analysis]
2:30pm mPlane components: reasoners [P. Casas, leader of mPlane work package on iterative and adaptive analysis]
3:00pm **Keynote by Alberto Dainotti, Center for Applied Internet Data Analysis (CAIDA)** *"BGPStream, A framework for the historical analysis and real-time monitoring of BGP data"*
Abstract: I will present the design and implementation of BGPStream, an open-source software framework (available at bgpstream.caida.org) for the analysis of historical and live Border Gateway Protocol (BGP) measurement data. Although BGP is a crucial operational component of the Internet infrastructure, and is the subject of fundamental research (in the areas of performance, security, topology, protocols, economy, ...), there is no standard and easy way of processing large amounts of BGP measurement data. BGPStream fills this gap by making available a set of API and tools for processing large amounts of live and historical data thus supporting investigation of specific events, rapid prototyping, and building complex tools and efficient large-scale monitoring applications (e.g., detection of connectivity disruptions or BGP hijacking attacks). I will describe the design choices and challenges in the development of BGPStream. I will present how the components of the framework can be used in different applicative scenarios, and I will describe the development and deployment of complex services for global Internet monitoring that we built on top of it.

4:00pm Live demos of mPlane use cases

2 Full list of research contributions to journals and conferences

Below are listed the research publications of the projects. In summary, the project has published more than 15 journal papers, and 100 conference papers.

Journal papers

1. Casas P. et al. Unveiling Network and Service Performance Degradation in the Wild with mPlane. IEEE Communications Magazine - Network Testing Series, 2016. To appear.

2. Bocchi E. et al. Personal Cloud Storage Benchmarks and Comparison. Cloud Computing, IEEE Transactions on, vol. PP, pp. 1-1, 2015. To appear.

3. Rufini A. et al. Multilevel Bandwidth Measurements and Capacity Exploitation in Gigabit Passive Optical Networks. Communications, IET, Dec-14 2014. IEEE New York, NY Volume:8, Issue: 18, pp 3357 - 3365 10.1049/iet-com.2014.0165.

4. Bermudez I. et al. A Distributed Architecture for the Monitoring of Clouds and CDNs: Applications to Amazon AWS. Network and Service Management, IEEE Transactions on, Dec-14 2014. IEEE New York, NY Volume:11, Issue: 4, pp 516 - 529 10.1109/TNSM.2014.2362357.

5. Casas P. et al. When YouTube Does not Work - Analysis of QoE-Relevant Degradation in Google CDN Traffic. Network and Service Management, IEEE Transactions on, Dec-14 2014. IEEE New York, NY Volume:11, Issue: 4, pp 441-457 10.1109/TNSM.2014.2377691.

6. Trammell B. et al. Evolving Transport in the Internet. Internet Computing, IEEE, Sep-14 2014. IEEE New York, NY Volume:18, Issue: 5, pp 60 - 64 10.1109/MIC.2014.91.

7. Papadimitriou D. et al. Practical issues for the implementation of survivability and recovery techniques in optical networks,. Elsevier Optical Switching and Networking, Aug-14 2014. Elsevier Berlin, Germany Volume 14, Part 2, pp 179–193 10.1016/j.osn.2014.05.002.

8. Du W. et al. Rating Network Paths for Locality-Aware Overlay Construction and Routing. IEEE/ACM Transactions on Networking, Jul-14 2014. ACM/IEEE New York, NY Volume:23, Issue: 5, pp 1661 - 1673 10.1109/TNET.2014.2337371.

9. Grimaudo L. et al. SeLeCT: Self-Learning Classifier for Internet Traffic. Network and Service Management, IEEE Transactions on, Jun-14 2014. IEEE New York, NY Volume:11, Issue: 2, pp 144 - 157 10.1109/TNSM.2014.011714.130505.

10. Gong Y. et al. Fighting the bufferbloat: on the coexistence of AQM and low priority congestion control. Elsevier Computer Networks, Jun-14 2014. Springer Heidelberg, Germany Volume 65, pp 255–267 10.1016/j.bjp.2014.01.009.

11. Trammell B. et al. mPlane: an Intelligent Measurement Plane for the Internet. IEEE Communications Magazine, Special Issue on Monitoring and Troubleshooting Multi-domain Networks using Measurement Federations, May-14 2014. IEEE New York, NY Volume:52, Issue: 5, pp 148 - 156 10.1109/MCOM.2014.6815906.

12. Testa C. et al. Delay-based congestion control: Flow vs. BitTorrent swarm perspectives. Elsevier Computer Networks, Feb-14 2014. Elsevier Berlin, Germany Volume: 60, pp 115 – 128 10.1016/j.bjp.2013.12.018.

13. Traverso S. et al. Temporal locality in today's content caching: why it matters and how to model it. ACM SIGCOMM Computer Communication Review, Oct-13 2013. ACM New York, NY Volume 43 Issue 5, pp 5-12 10.1145/2541468.2541470.

14. Liao Y. et al. DMFSGD: A decentralized matrix factorization algorithm for network distance prediction. IEEE/ACM Transactions on Networking, Oct-13 2013. ACM/IEEE New York, NY Volume 21 Issue 5, pp 1511 - 1524 10.1109/TNET.2012.2228881.

15. Casas P. et al. YOUQMON: A System for On-line Monitoring of YouTube QoE in Operational 3G Networks. ACM SIGMETRICS Performance Evaluation Review - Special issue on the 31st international symposium on computer performance, modeling, measurements and evaluation (IFIPWG 7.3 Performance 2013), Sep-13 2013. ACM New York, NY Volume 41 Issue 2, pp 44-46 10.1145/2518025.2518033.

16. Marcelo B. et al. Standardizing large-scale measurement platforms. ACM SIGCOMM Computer Communication Review, Apr-13 2013. ACM New York, NY Volume 43 Issue 2, pp 58-63 10.1145/2479957.2479967.

17. Simoncelli D. et al. Stream-monitoring with blockmon: convergence of network measurements and data analytics platforms. ACM SIGCOMM Computer Communication Review, Apr-13 2013. ACM New York, NY Volume 43 Issue 2, pp 29-36 10.1145/2479957.2479962.

Conference papers

1. Vanaubel Y. et al. A Brief History of MPLS Usage in IPv6. Passive and Active Measurement Conference (PAM), Mar-16 2016. Springer Heraklion, Greece. To appear.

2. Casas P. et al. Unveiling Network and Service Performance Degradation in the Wild with mPlane. IEEE Communications Magazine - Network Testing Series, TBD 2016. IEEE TBD. To appear.

3. Cicalese D. et al. Characterizing IPv4 Anycast Adoption and Deployment. CoNEXT 2015 The 11th International Conference on emerging Networking EXperiments and Technologies, Dec-15 2015. ACM Heidelberg, Germany TBD. To appear.

4. Wassermann S. et al. Towards DisNETPerf: a Distributed Internet Paths Performance Analyzer. The 11th International Conference on emerging Networking EXperiments and Technologies - CoNEXT 2015, Dec-15 2015. ACM Heidelberg, Germany TBD. To appear.

5. Faath M. et al. A GLIMPSE of the Internet's Fabric. 9th EAI International Conference on Performance Evaluation Methodologies and Tools (ValueTools), Dec-15 2015. EAI/ACM Berlin, Germany TBD. To appear.

6. Liao Y. et al. A Lightweight Network Proximity Service Based On Neighborhood Models. 22nd IEEE Symposium on Communications and Vehicular Technology in the Benelux (SCVT), Nov-15 2015. IEEE Luxembourg 1 - 6 10.1109/SCVT.2015.7374218.

7. Casas P. et al. Taming QoE in Cellular Networks: from Subjective Lab Studies to Measurements in the Field. Network and Service Management (CNSM), 2015 11th International Conference on, Nov-15 2015. IEEE Barcelona, Spain 237 - 245 10.1109/CNSM.2015.7367364.

8. Faath M. et al. Measurements with the Masses. Proceedings of the first IRTF/ISOC Workshop on Research and Applications of Internet Measurements (RAIM), Oct-15 2015. ACM Yokohama, Japan TDB. To appear.

9. Trammell B. et al. Observing Internet Path Transparency to Support Protocol Engineering. Proceedings of the first IRTF/ISOC Workshop on Research and Applications of Internet Measurements (RAIM), Oct-15 2015. ACM Yokohama, Japan TBD. To appear.

10. Casas P. et al. Taming QoE in Cellular Networks: from Subjective Lab Studies to Measurements in the Field. Proceedings of the first IRTF/ISOC Workshop on Research and Applications of Internet Measurements (RAIM), Oct-15 2015. ACM Yokohama, Japan TDB. To appear.

11. Faath M. et al. A Cautious Look at Using Internet Standards-to-be in Research Work. 2015 IEEE Conference on Standards for Communications and Networking (CSCN15), Oct-15 2015. IEEE Tokyo, Japan TBD. To appear.

12. Vanaubel Y. et al. MPLS Under the Microscope: Revealing Actual Transit Path Diversity. the 2015 ACM Conference on Internet Measurement Conference (IMC), Oct-15 2015. ACM Tokyo, Japan 49-62 10.1145/2815675.2815687.

13. Trammell B. et al. A New Transport Encapsulation for Middlebox Cooperation. Proceedings of the 2015 IEEE Conference on Standards for Communications and Networking, Oct-15 2015. IEEE Tokyo, Japan TBD. To appear.

14. Bocchi E. et al. Personal Cloud Storage: Usage, Performance and Impact of Terminals. 4th IEEE International Conference on Cloud Networking (IEEE CloudNet 2015), Oct-15 2015. IEEE Niagara Falls, Canada 106 - 111 10.1109/CloudNet.2015.7335291.

15. Papadimitriou D. et al. Robust cooperative monitoring problem. Reliable Networks Design and Modeling (RNDM), 2015 7th International Workshop on, Oct-15 2015. IEEE Munich, Germany 186 - 193 10.1109/RNDM.2015.7325228.

16. Kutzkov K. et al. Weighted Similarity Estimation in Data Streams. CIKM '15 Proceedings of the 24th ACM International on Conference on Information and Knowledge Management, Oct-15 2015. ACM Melbourne, Australia 1051-1060 10.1145/2806416.2806515.

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25. Fiadino P. et al. Towards Automatic Detection and Diagnosis of Internet Service Anomalies via DNS Traffic Analysis. 6th International Workshop on Traffic Analysis and Characterization (TRAC), Aug-15 2015. IEEE Dubrovnik, Croatia 373 - 378 10.1109/IWCMC.2015.7289112.

26. Callegari C. et al. Troubleshooting Web Sessions with CUSUM. 6th International Workshop on Traffic Analysis and Characterization (TRAC), Aug-15 2015. IEEE Dubrovnik, Croatia 385 - 390 10.1109/IWCMC.2015.7289114.

27. Seufert M. et al. YouTube QoE on Mobile Devices: Subjective Analysis of Classical vs. Adaptive Video Streaming. 6th International Workshop on Traffic Analysis and Characterization (TRAC), Aug-15 2015. IEEE Dubrovnik, Croatia 43 - 48 10.1109/IWCMC.2015.7289055.

28. Bocchi E. et al. Impact of Carrier-Grade NAT on Web Browsing. 6th International Workshop on Traffic Analysis and Characterization (TRAC), Aug-15 2015. IEEE Dobrovnik, Croatia 532 - 537 10.1109/IWCMC.2015.7289140.

29. Casas P. et al. QoMOSN - On the Analysis of Traffic and Quality of Experience in Mobile Online Social Networks. Networks and Communications (EuCNC), 2015 European Conference on, Jul-15 2015. IEEE Paris, France 471 - 475 10.1109/EuCNC.2015.7194120.

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33. Papadimitriou D. et al. Distributed monitoring problem. 7th International Network Optimization Conference, INOC, May-15 2015. Warsaw, Poland TBD. To appear.

34. Fiadino P. et al. Online Social Networks anatomy: On the analysis of Facebook and WhatsApp in cellular networks. IFIP Networking Conference (IFIP Networking), 2015, May-15 2015. IFIP Toulouse, France TBD 10.1109/IFIPNetworking.2015.7145326.

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51. Tego E. et al. Quality of Service Management based on Software Defined Networking Approach in wide GbE Networks. Euro Med Telco Conference (EMTC), 2014, Nov-14 2014. IEEE Naples, Italy 1 - 5 10.1109/EMTC.2014.6996660.

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