Applications of GridProbe Technology for Traffic Monitoring on High-Capacity Backbone Networks

Data-Link Layer Simulation Approach

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***Abstract*: This paper covers the on-going research on MASTS project. The project objectives are to set-up and exploit a traffic monitoring system for the UKLIGHT international high capacity experimental network. The proposed system will record data flow and topological information at a range of time scales (from fractions of a second to years). It will make this information available to the community as a web service and management interfaces. In this paper the focus is on development of simulation platforms that enable testing the analysis algorithms and Web services output. Keywords-component Traffic characterization, Network simulation, Web services**

I. INTRODUCTION

The emergence of high speed internet access and government plans to push the broadband to homes and schools has increased the importance of core backbone IP networks. However the type of traffic on networks changes rapidly with the development of new technologies, such as streaming audio/video applications and peer-to-peer networking. Such new applications have caused rapidly increased the traffic burden on core internet routers and the need to monitor the traffic types, which had not been fully considered in development of protocols such as SNMP and PING, has become a vital part of network architecture design. Recently there have been projects in the e-science framework to enable data collection on core activities on such high speed networks such as the IPMON[1] project for the Sprint IP Backbone and the Grid-Probe[2] project as a scalable monitoring platform for the GRID.

The MASTS project is a £1.2M EPSRC project to measure the evolution of the topology and traffic in and around the UKLight Network. UKLight is a national facility in UK to support projects working on developments towards 10Gbps optical networks and the applications that will use them. It consists of a collection of Points-of-Presence (PoP) connected together via dark fibre. One important aspect of the UKLight is the fact that overall it is a switched system and there are no routers deployed. As a result of this, it acts as an Ethernet in reality and it does not allow standard routing protocols and algorithms to be used for monitoring purposes.

The objectives of the MASTS project are [3]:

- Develop and deploy Grid Probe technology on the network
- Develop 'back end' feature extraction and data compression
- Archive flow traces and statistics
- Provide real-time views on specific flows for other UKLight users
- Provide access to archive data via Web-Services

II. ARCHITECTURE OF THE MONITORING PLATFORM

Figure 1 displays the architecture of the monitoring and proposed analysis and web services platform.

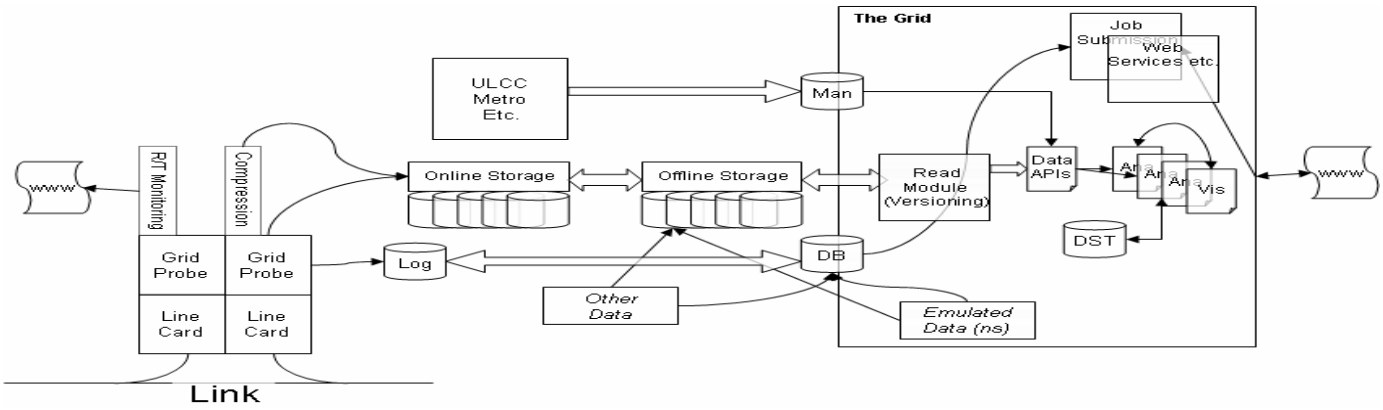

Figure 1: System architecture of the MASTS network monitoring platform

This work is conducted as part of MASTS project under an EPSRC grant.

In the initial phase of this project there is need for a simulation platform for the whole system. This simulation is based on the architecture of the MASTS monitoring system. Grid Probes are located at each Point of Presence (PoP) and they capture the packets at full rate using high speed line cards. This will then be analyzed using fast feature extraction algorithms, as opposed to pure packet and header dumping like TCPDUMP [4], to avoid extremely large file storage needs. The interesting information is analyzed using a GRID of computers and presented in XML format to various Web services interconnected to the monitoring platform. The authors' contribution to the project is mainly focused on research into fast data compression and feature extraction algorithms and the Web services. However the physical synthesis of the Grid Probes is not complete at present and the need arises for a simulation platform to test the algorithms and network architecture. This simulation platform should have characteristics equivalent to the UKLight so that it can be ported to the Grid service engines once the hardware development is completed.

III. Simulation of the UKLight Network

The analysis of the feature extraction and compression algorithms, alongside with traffic pattern monitoring, requires a configurable network which enables the user to set traffic models and data rates and the analysis results must be able to verify the behaviour of the network switches and traffic loss models. This brings the need for a simulation platform of UKLight network, which allows various configurations of the network traffic patterns. Various simulation tools were available, including J-Sim [5], Iperf [6] and Network Simulator 2 (NS2) [7] but none of them produce realistic packets due to complexity of the packet generation. However, [NS2] is good at modelling the traffic at network layer and as this project has emphasis on IP traffic, NS2 was chosen to model the UKLight network. The output trace file includes various prototypes of routing information such as source and destination, protocol, timing and sequence numbers. The output trace file can then be fed into TCL and C scripts in order to append various Ethernet headers and fields to it and then feed the results into the analysis algorithms. Figure 2 displays the architecture used in the simulation environment.

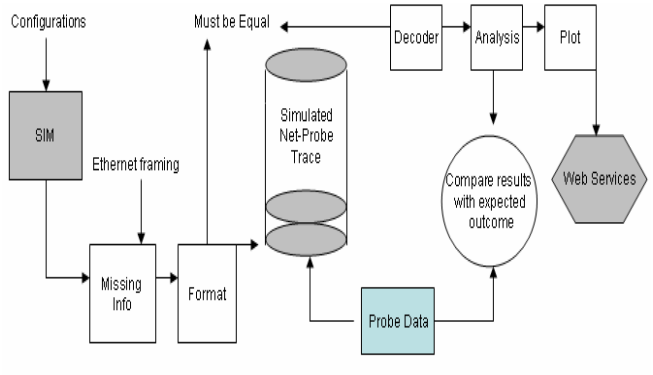

Figure 2: Simulation protocol

The simulations have the following steps:

1. Store the trace file components into a C structure.
2. Convert the structure components into equivalent IP header and Ethernet MAC addresses.
3. Compose complete Ethernet frames from each individual simulation event using the above.
4. Feed the output file into statistical programs.
5. Produce information on loss, node traffic and link statistics and feed these into web services.

IV. Web Services

The data generated by the simulation platform, as well as the real probe data, will be archived in a standard format and will be accessible through a number of Web services. The Web services are specified in WSDL [8] and thus, other GRID applications will be able to invoke the services functionality, which will include querying facilities for trace retrieval and access to analysed data. We are currently defining a suitable metadata system for capturing all metadata about trace files (e.g. how/where the traces were recorded) as well as network configuration, probe information, etc. This metadata is being implemented as a relational database (MySQL [9]), to be directly accessible through Web services. The aim of establishing a well-defined metadata schema is to guarantee the long term usefulness of the data sets, which the MASTS project aims to achieve. A web-based user interface is also being developed to provide access to the simulation data (and later on to real data as well as analysed data), by invoking the Web services functionality. The Java Servlet technology [10] and the Apache AXIS SOAP processing engine [11] are being used.

V. Summary and Future Work

The use of simulation platform allows set-up and modification of different scenarios of the UKLight network traffic pattern and the results should be able to verify the behaviour of the system. Once this is completed, the analysis platform is going to be ported to the real-time system to enable acquisition and broadcasting of interesting details for the wider research community using the UKLight facility.

References

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