Bandwidth Management and Optimisation

Objective of this Note

This Note is targeted at NRENs, and their member institutions, that face the challenge of making optimum use of limited and expensive bandwidth. Bandwidth typically takes up in excess of 70% of the budget available to the Information Resource Management (IRM)[1] units of universities. This is also a very significant portion of the overall institutional budge. Proper management is therefore essential to ensure cost-effective utilization.

The Note is part of a set of tools that has been developed by the UbuntuNet Alliance for Research and Education Networking to support the growth of REN activity in the continent with the intent of empowering and creating global equity for Africa-based educationists and researchers.[2]

1. INTRODUCTION

Many institutions, faced with the challenge of gaining maximum utility out of limited and expensive bandwidth, tend to use ad hoc interventions, for example blocking what are subjectively considered undesirable sites, to improve utilisation. This often pits the Information Resource Management Unit against users, and produces only partial solutions to a major challenge. In this note, we outline a more holistic approach that should provide institutions with a more effective framework for bandwidth management and optimisation.

2. KEY STEPS IN MANAGEMENT AND OPTIMISATION

2.1 Monitor Supply and Utilisation

Bandwidth and traffic monitoring are key activities in any institution: unfortunately they are often ignored. There are many open source tools that can enable cash-strapped institutions, even with limited technical capacity, to carry out effective monitoring. Monitoring supply and utilisation gives data and information about:

i.   Whether or not the supplier is delivering as per agreed service level agreement, both in terms of quality and quantity. This presupposes that the supply contract includes a good Service Level Agreement (SLA)[3].
ii.   What type of traffic is running on the network (mail; viruses; spam; academic and research; etc) and what volume of available resources each type is taking.

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[1] IRM Units are commonly referred to as ICT or IT Support units.
[2] We acknowledge with thanks and appreciation the role that has been played by Dr Duncan Martin, Dr Lishan Adam, Mr Victor Kyalo, and Dr F F Tusubira in the development of these notes. Note UA 155 was developed by Dr F F Tusubira.
[3] Service Level Agreements are covered in a different note

iii.   General usage patterns: peak hours and low usage hours.

iv.   Who is consuming how much bandwidth, for what purpose, and at what times. This presupposes an ability to isolate traffic through public IP addresses. The acquisition of IP addresses is covered in Note UA 152 to 153[4].

The data generated through this kind of monitoring provides a proper basis for the next action: development of policy for bandwidth management and optimisation.

2.2 Establish the Bandwidth Usage Policy

Policy is based on the rationale of ensuring that institutional resources are directed, as a priority, to the core mandates of the institution: education, research, and outreach for most universities in developing countries. It is strongly recommended that the arguments and policies for bandwidth management and optimisation are driven by resource rather than subjective moral considerations, especially in academic and research settings.

Policy in this case sets the priority areas to which bandwidth should be allocated. It should go through a proper process of institution-wide debate and understanding, so that users readily bear the inconveniences that some of the interventions lead to. The policy document itself should explain clearly why certain steps are being taken as a constant reminder to users. It should also be noted that bandwidth policy needs to rest on the higher level institutional ICT Policy, and work alongside the institutional Acceptable Use Policy.

2.3 Develop Specific Strategies and Tactics for Bandwidth Management

The specific strategies and tactics will be informed by the policy as well as the data generated by monitoring and evaluation. The following are common examples:

i.   Most general usage patterns will show flat peaks during the day (ie, all available capacity consumed) from 8am to 6pm, after which utilisation drops almost to zero. This points to:
    a. Extending the opening hours of computer labs. Some campuses now provide 24-hour opening.
    b. Scheduling major downloads at night.
    c. Extending connectivity to student halls of residence.

ii.   Viruses and spam have been known to take up as much as 70% of available bandwidth. The monitoring data will establish how much bandwidth is wasted this way. A campus wide anti-virus solution is a key necessity, as are spam filters. Many anti-virus updates offer automatic updates whenever a computer is connected: this in itself consumes a lot of bandwidth. Only a limited number of servers that then distribute virus databases to sub-nets should be permitted direct access. Remote mail scrubbing[5] to eliminate viruses and identify spam is a feasible approach at NREN level where the level of aggregation and traffic volume justifies the investment.

iii.   Online email systems (Google, Yahoo, Hotmail, and others) consume a lot of bandwidth because, apart from the direct overhead of maintaining many open links, there is the overhead of sponsor's traffic. Users however enjoy the interactivity and "anywhere" access convenience of web mail. It will most likely be necessary to block

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[4] Visit http://www.ubuntunet.net/how-to
[5] This requires that virus and spam filters are used in high bandwidth locations (Europe, USA, the Far East) before traffic is directed to the limited bandwidth of the institutions in developing countries.

access to the popular web mail services during peak hours, but this requires that an internal web mail system that offers the same nature of access and convenience is developed first. This can be done using open source tools: many institutions in Africa have been able to develop advanced web mail services using such tools.

iv. Low relevance websites will in many cases be found to consume a lot of bandwidth. (Relevance and relevance priority is determined at policy level, not at operational level). These are mostly entertainment and social interaction websites. Music, film, and photograph downloads, for example, are very bandwidth intensive. A possible solution is blockage of such sites during peak hours. A more advanced approach is the dynamic gradual squeezing down of bandwidth available to a terminal that accesses such websites.

v. Academic and research downloads can also be very bandwidth intensive. In addition to scheduling downloads during off peak hours as already discussed, popular sites need to be identified and, where possible, agreements entered into that allow mirroring the content of such sites on the intranet. Caches and proxy servers also provide temporary local storage of pages reducing the need for repeated international access for popular downloads.

vi. Traffic statistics that show a very low level of intranet traffic point to an intranet that has not been designed to provide value – other than connectivity – to the institution. A good intranet makes *the Intranet* the first choice of call for users.

These are just some of the common examples. Many more can be added to this list.

2.4 Develop the Human Resource

For most African institutions, development of the human resource will be a concurrent activity. It must be addressed initially within the University ICT Policy where the IRM human resource needs and sustainability issues around the human resource are considered. The staff is then trained on an ongoing basis so that they can evolve the strategies and tactics, and also implement them. As noted by the Alliance[6], executive and related skills will also be required by the staff. Organisations like AfNOG[7] and INASP[8] have been running bandwidth management and optimisation workshops that offer a lot of insight.

2.5 Create Linkages with other Institutions

Many institutions within the UbuntuNet Alliance membership region have made considerable progress in bandwidth management and optimisation, and are a ready source of peer skills that will help in both capacity development and implementation of agreed approaches. The Alliance, as part of its capacity building strategy, enables such secondments and attachments that help institutions to rapidly build and utilise the required capacity.

3. CONCLUSION

It is evident that bandwidth management and optimisation is a multi-faceted challenge. The holistic approach outlined will enable institutions to reduce it to strategies and tactics that will, over time, make a significant difference to the cost-effective utilisation of bandwidth.

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[6] See UA 203 – UbuntuNet Alliance Training Needs Analysis
[7] See http://www.afnog.org/
[8] See http://www.inasp.info/. INASP has several resources related to bandwidth management and optimisation.