ЎЗБЕКИСТОН РЕСПУБЛИКАСИ АХБОРОТ ТЕХНОЛОГИЯЛАРИ ВА КОММУНИКАЦИЯЛАРИНИ РИВОЖЛАНТИРИШ ВАЗИРЛИГИ

МУҲАММАД АЛ-ХОРАЗМИЙ НОМИДАГИ ТОШКЕНТ АХБОРОТ ТЕХНОЛОГИЯЛАРИ УНИВЕРСИТЕТИ

ЎЗБЕКИСТОН РАДИОТЕХНИКА, ЭЛЕКТРОНИКА ВА АЛОҚА ИЛМИЙ-ТЕХНИКА ЖАМИЯТИ

ИҚТИСОДИЁТНИНГ РЕАЛ ТАРМОҚЛАРИНИ ИННОВАЦИОН РИВОЖЛАНИШИДА АХБОРОТ–КОММУНИКАЦИЯ ТЕХНОЛОГИЯЛАРИНИНГ АҲАМИЯТИ

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ЗНАЧЕНИЕ ИНФОРМАЦИОННО-КОММУНИКАЦИОННЫХ ТЕХНОЛОГИЙ В ИННОВАЦИОННОМ РАЗВИТИИ РЕАЛЬНЫХ ОТРАСЛЕЙ Э КОНОМИКИ

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cause of congestion, the expansion of router buffers to hold more and more packets for transmission instead of dropping them more rapidly. Such concerns have not prevented network administrators from installing DPI equipment in their networks or from monitoring and acting on data packets.

The network operator has made some kind of decision about the appropriateness of the applications that end-users are employing: either some applications are more important than others or are identified as problematic and thus have special rules crafted to mediate their ability to generate congestion. Using DPI, a network operator can also shift focus from the application to the user. In this situation, an administrator might establish conditions concerning how clients can utilize available bandwidth. As an example, when a client has used its maximum allotted bandwidth for a 15-minute interval, it might have *all* of its traffic deprioritized or delayed for a period of time following the interval. This action has the effect of prioritizing 'bursty' traffic, that which transmits data in short intervals rather than over a long period of time. Accessing webpages generates bursty traffic, whereas long file transfers using either peer-to-peer applications or a file transfer client are non-bursty types of traffic. This user-centric approach can be seen as 'application agnostic', insofar as it does not target specific applications, though the rule set will disproportionately affect some applications, such as peer-to-peer and FTP clients, over others, such as web browsing.

THE ECONOMIC POTENTIALS OF DPI

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The ability to examine and act upon data packets in real time affords new revenue opportunities for ISPs and third parties alike, as well as offering ways to curtail threats to revenue maximization. Specifically, Internet service providers may be motivated to offer differentiated service plans that compete based on what applications customers can use to connect to the web, the priority that applications' packets are given at routers, or the speed at which users can access websites. ISPs may also prioritize their own 'value added' services, such as voice over Internet protocol, email, or home security systems, over services offered by their competitors. Parties other than network owners may also be interested in DPI: copyright holders may try to limit the sharing of files that infringe on copyrights, and advertisers may monitor and mine data traffic to identify consumer habits and subsequently modify packets to serve targeted ads.

ISPs have offered differentiated service plans since dial-up modem pools were used to connect to the Internet. Today, broadband connections mean that ISPs compete based on the rate that data is exchanged between the client's location and the Internet, the volume of data they are permitted to transfer each month, value-added services such as email accounts, and cost of service delivery. DPI lets ISPs further distinguish their offerings by selectively letting applications connect to the Internet; a web browser and email client connection might be included in a 'basic' Internet package, whereas video game applications or streaming music applications might be included in a 'premium' package. The fungibility of DPI and deep integration with policy control servers afford advantages over prior networking technologies, such as MPI, insofar as the same device is better able to mediate multiple different data forms and formats. Further, whereas some data types, such as web traffic, or data sources, such as a national online newspaper, might not be counted towards a monthly data quota, other data types and sources could. Alternatively, an ISP could limit or prevent access to the Internet unless customers pay for each connected device; DPI can be used to examine data traffic and ascertain whether 'registered' or 'unregistered' devices are attempting to access the Internet and, in the case of unregistered devices, limit their access until a fee is paid. Figure four gives a theoretical example of what these kinds of pricing formats might look like.

This limitation by device is part of an 'app-model' for the Internet, where connectivity is bundled with a particular application, such as an online movie watching application, or a particular device, such as a PC or tablet computer. In an app-based model, users may never see how much bandwidth volume or capacity they are afforded and instead enjoy only selective access to the Internet based on the services paid for on a monthly basis. This approach to Internet pricing might be combined with, or supplemented by, a prioritization of an ISP's own services to the detriment of competitors. The ISP's voice over Internet protocol client, or a client belonging to a company that had paid an ISP, might be 'free' with the basic package whereas competitors' VoIP traffic is given a lower priority. This approach could buttress an ISP's complementary products or enhance revenue when competitors pressure those complementary product lines. DPI could be used to identify favored applications and give them preferential treatment by guaranteeing higher levels of priority, making larger volumes of bandwidth available to them, or by not counting the data they generate against users' monthly volume limits. An ISP's exclusion of competing services or rent seeking may be logical from the stance of economics. More specifically, "[a]s long as the exclusion of rivals from its Internet-service customers translates into more sales of its complementary product, and the additional profits are larger than the costs of exclusion, exclusion will be a profitable strategy." Given the relative prevalence of viruses, malware, and spyware the exclusion of competing applications may be couched simultaneously in the languages of service and security, which mask the core economic drivers behind the facade of technical improvements to the network.

DPI also provides copyright holders with a tool to (try to) limit or monitor the traffic of infringing computer files and data streams that course across the Internet. To date, most analyses of infringing data traffic rely on questionable statistics or shoddy methodologies. In the case of the former, the United States' Government Accountability Office (GAO) has publicly rebuffed the monetary losses that American corporations claim to experience from infringement. The GAO notes that for widely cited statistics no studies exist that support estimated losses, and that efforts to evaluate actual losses suffer from methodological limitations. The introduction of detailed packet analysis equipment begins to resolve some of the methodological problems associated with quantifying infringing data traffic; by monitoring packets and cross-referencing them against their point of origin – are they from 'legitimate' digital retailers – and their contents – do the files contain copyrighted material – it is theoretically possible to develop an index of how much unencrypted data traffic is potentially infringing. If the copyright monitoring system isn't intended to prevent the movement of data, but merely log it, a DPI system could be established to do a quick analysis of packets to identify their likely contents. Where it identifies the packets as potentially holding infringing content, they could be passed to their destination, while copies are made and stored in a short-term offline storage system. Once in that system, a computer program could develop a hash value for the files and compare it against a known list of copyrighted files. Where the file was protected under copyright and the source of the transmission was an illegitimate online content provider, the storage system could call on the subscriber database, correlate the subscriber's personal information with the inappropriate exchange of infringing material, and notify an ISP administrator or member of council, copyright holders, authorities, or some other designated party.

One problem with using a hash-based analytic system is that minor changes in the file can result in different values being generated. These values would not align with the database of known hashes, and thus the DPI or offline analysis system would not identify the files as potentially infringing.

ASPECTS OF CELLULAR NETWORKS

E.M. Zarmasov (TUIT, assistant)

In 1921, Detroit police used a one-way dispatch communication in the range of 2 MHz to transmit information from a central transmitter to a receiver mounted on cars - it was the

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