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SERIES X: DATA NETWORKS, OPEN SYSTEM COMMUNICATIONS AND SECURITY

OSI management – Management functions and ODMA functions

The measurement framework for the statistical indicators of website traffic

Recommendation ITU-T X.760

ITU-T X-SERIES RECOMMENDATIONS

DATA NETWORKS, OPEN SYSTEM COMMUNICATIONS AND SECURITY

PUBLIC DATA NETWORKS	
Services and facilities	X.1–X.19
Interfaces	X.20–X.49
Transmission, signalling and switching	X.50–X.89
Network aspects	X.90–X.149
Maintenance	X.150–X.179
Administrative arrangements	X.180–X.199
OPEN SYSTEMS INTERCONNECTION	
Model and notation	X.200–X.209
Service definitions	X.210–X.219
Connection-mode protocol specifications	X.220–X.229
Connectionless-mode protocol specifications	X.230–X.239
PICS proformas	X.240–X.259
Protocol Identification	X.260–X.269
Security Protocols	X.270–X.279
Layer Managed Objects	X.280–X.289
Conformance testing	X.290–X.299
INTERWORKING BETWEEN NETWORKS	
General	X.300–X.349
Satellite data transmission systems	X.350–X.369
IP-based networks	X.370–X.379
MESSAGE HANDLING SYSTEMS	X.400–X.499
DIRECTORY	X.500–X.599
OSI NETWORKING AND SYSTEM ASPECTS	
Networking	X.600–X.629
Efficiency	X.630–X.639
Quality of service	X.640–X.649
Naming, Addressing and Registration	X.650–X.679
Abstract Syntax Notation One (ASN.1)	X.680–X.699
OSI MANAGEMENT	
Systems management framework and architecture	X.700–X.709
Management communication service and protocol	X.710–X.719
Structure of management information	X.720–X.729
Management functions and ODMA functions	**X.730–X.799**
SECURITY	X.800–X.849
OSI APPLICATIONS	
Commitment, concurrency and recovery	X.850–X.859
Transaction processing	X.860–X.879
Remote operations	X.880–X.889
Generic applications of ASN.1	X.890–X.899
OPEN DISTRIBUTED PROCESSING	X.900–X.999
INFORMATION AND NETWORK SECURITY	X.1000–X.1099
SECURE APPLICATIONS AND SERVICES (1)	X.1100–X.1199
CYBERSPACE SECURITY	X.1200–X.1299
SECURE APPLICATIONS AND SERVICES (2)	X.1300–X.1499
CYBERSECURITY INFORMATION EXCHANGE	X.1500–X.1599
CLOUD COMPUTING SECURITY	X.1600–X.1699

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T X.760

The measurement framework for the statistical indicators of website traffic

Summary

Recommendation ITU-T X.760 describes the measurement framework for the statistical indicators of website traffic.

Websites are one of the largest traffic sources of telecommunication networks. It is necessary for network operators to understand the characteristics of website traffic and measurement methodologies to plan and optimize their networks for providing a better quality of service to websites and end users.

This Recommendation defines three key statistical indicators (KSIs) including 8 sub-indicators of website traffic and describes the measurement framework including the measurement environment and measurement procedure for KSIs of website traffic. This Recommendation is aimed at providing network operators with a means to benchmark websites for scaling and optimizing network infrastructures.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T X.760	2018-01-13	2	11.1002/1000/13480

Keywords

Statistical indicator, website traffic.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

Table of Contents

Recommendation ITU-T X.760

The measurement framework for the statistical indicators of website traffic

1 Scope

This Recommendation defines a framework, and identifies the key statistical indicators and their measurement methodology, for characterizing website traffic. It aims to provide network operators with a means to benchmark websites for scaling and optimizing network infrastructures.

2 References

None.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 website traffic: The amount of data sent to a website and received from a website by visitors.

3.2.2 key statistical indicators of website traffic: The parameters used to characterize website traffic. In this Recommendation, they are derived from the measurement of website traffic, such as source IP indicator, visitor indicator, page view indicator, etc.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ETL Extract Transform Load

IP Internet Protocol

KSI Key Statistical Indicator

PC Personal Computer

QoE Quality of Experience

QoS Quality of Service

5 Conventions

None.

6 Introduction

Websites have become one of the largest traffic sources in telecommunication networks. It is important to characterize and measure website traffic to help plan and optimize telecommunication networks. Most of the time, key statistical indicators are used to characterize website traffic. There are several ways to collect different statistical indicators of website traffic for different purposes, such as client software mode, website-embedded code mode and cookie mode, etc. This

Recommendation provides the measurement framework for statistical indicators of website traffic for planning and optimizing network infrastructures.

7 Key statistical indicators of website traffic

The following key statistical indicators of website traffic are used in this Recommendation. Each indicator may have one or more sub-indicator.

An indicator or sub-indicator is calculated in a statistical period. The units of the statistical period are minutes, hours, days, weeks, months, etc.

7.1 Source IP indicator

7.1.1 General description

The source IP indicator is an indicator related to the source IP address accessing the website to be measured in a statistical period of time. In this Recommendation the source IP indicator has two sub-indicators: the number of unique IP addresses and the spatial distribution of unique IP addresses.

7.1.2 Sub-indicators

7.1.2.1 Number of unique IP addresses

The number of unique IP addresses is the total number of different source IP addresses accessing the website to be measured in a statistical period.

If several visitors share one IP address, only one unique IP address is counted. When a visitor uses several different IP addresses in different periods, multiple unique IP addresses are counted. So the number of unique IP addresses is generally different from the number of unique visitors.

The number of unique IP addresses reflects the service coverage of a website.

7.1.2.2 Spatial distribution of unique IP addresses

The spatial distribution of unique IP addresses is the spatial distribution of all the source IP addresses accessing the website to be measured in a statistical period among Internet service providers and spatial locations.

The spatial distribution of unique IP addresses is the reflection of users' Internet service providers and locations.

7.1.3 Application

Network operators may optimize their network infrastructures according to the number of unique IP addresses and the spatial distribution of unique IP addresses.

7.2 Visitor indicator

7.2.1 General description

The visitor indicator is used to distinguish different visitors accessing the website during a statistical period. This indicator has one sub-indicator: number of unique visitors.

7.2.2 Sub-indicators

7.2.2.1 Number of unique visitors

The number of unique visitors is the total amount of different visitors accessing the website during a statistical period.

The number of unique visitors reflects the visitor coverage of the website.

7.2.3 Application

When the number of unique visitors increases or decreases sharply, something abnormal might have happened to the website, such as a service going online or offline. The network operators need to optimize their network in time to match the rapidly changing number of unique visitors.

7.3 Page view indicator

7.3.1 General description

The page view indicator is the network traffic caused by the volume of web pages of the website to be measured, which are viewed by visitors in a statistical period. In this Recommendation, web page refers to all types of media, such as text, image, file, audio or video, etc., within the website to be measured. The page view indicator has five sub-indicators: total volume of network traffic, average volume of network traffic per unique IP address, total bandwidth occupied by the website, average bandwidth occupied per unique IP address, the maximum bandwidth occupied by a unique IP address.

7.3.2 Sub-indicators

7.3.2.1 Total volume of network traffic

The total volume of network traffic is the total volume of network traffic caused by all the visitors accessing the website to be measured; this includes the network traffic sent to the website and received from the website by visitors in a statistical period. The total volume of network traffic is measured in bits.

The total volume of network traffic reflects the volume of network traffic which should be transmitted through telecommunication networks in a statistical period.

7.3.2.2 Average volume of network traffic per unique IP address

The average volume of network traffic per unique IP address is the average volume of network traffic caused by one unique IP address accessing the website to be measured during a statistical period. The average volume of network traffic per unique IP address is measured in bits per second.

The average volume of network traffic per unique IP address reflects the average volume of network traffic for one unique IP address which should be transmitted by telecommunication networks in a statistical period.

7.3.2.3 Total bandwidth occupied by the website

The total bandwidth occupied by a website is the total network bandwidth occupied by the website to be measured while it provides services to the users in a statistical period. The total bandwidth occupied by the website is measured in bits per second.

The total bandwidth occupied by the website reflects the network bandwidth requirements of the website.

7.3.2.4 Average bandwidth occupied per unique IP address

The average bandwidth occupied per unique IP address is the average bandwidth occupied by one unique IP address. It equates to the total bandwidth occupied by the website divided by the number of unique IP addresses. The average bandwidth occupied per unique IP address is measured in bits per second.

The average bandwidth occupied per unique IP address reflects the average network bandwidth requirements for a unique IP address accessing the website to be measured.

7.3.2.5 The maximum bandwidth occupied by a unique IP address

The maximum bandwidth occupied by a unique IP address is the maximum bandwidth occupied by a unique IP address accessing the website to be measured in a statistical period of time with all the unique IP addresses. The maximum bandwidth occupied by a unique IP address is measured in bits per second.

The maximum bandwidth occupied by a unique IP address reflects the maximum network bandwidth requirement for a unique IP address accessing the website to be measured.

7.3.3 Application

The page view indicator reflects network traffic caused by visitors accessing a website. The rapid increase of total bandwidth occupied by a website implies that there might be new applications, more video-type content, more large files in the website compared to before; network operators should plan to prepare more bandwidth for the website to meet its requirements. The maximum bandwidth occupied by a unique IP address indicates the maximum bandwidth requirements of a unique IP address, and the network operators should plan their network capability to meet visitors' requirements.

8 Measurement framework

8.1 Measurement environment

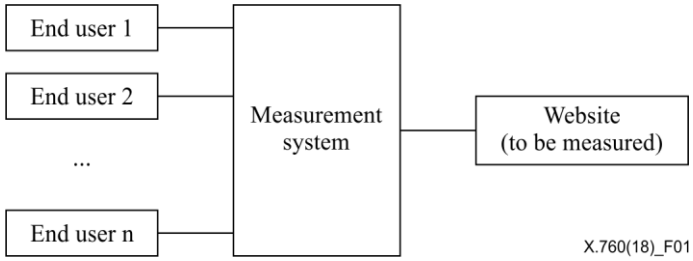

Figure 1 – Measurement environment for the KSIs of a website

The measurement environment for the KSIs of website traffic is shown in Figure 1. The measurement system can take different modes, and it can be a dedicated probe or a software on a PC. The measurement system calculates and provides the results of KSIs of website traffic based on the data acquired and collected from network flows between the end users and the website to be measured.

8.2 Measurement procedure

The measurement procedure for the key statistical indicators of website traffic includes data acquisition, data collection, data extract transform load (ETL), data calculation, result storage, etc., as shown in Figure 2.

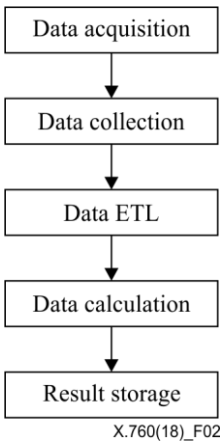

Figure 2 – Measurement procedure

8.2.1 Data acquisition

Data acquisition will get the network traffic information of a website according to the measurement purpose. Whether the measurement purpose can be achieved or not depends on the data acquired. Data acquired should include all the data elements needed to calculate the KSIs for the measurement purpose.

8.2.2 Data collection

Data collection will collect the data sent by data acquisition and store the collected data. The collected data is the original data source for KSIs' calculation. It should be kept for a relatively long duration after they are used, according to the measurement purpose.

8.2.3 Data ETL

Data ETL will get the required fields and delete the useless data. Whether the data is useful or useless depends on the measurement purpose. Sometime data ETL needs to take the responsibility of reducing the sensitivity of data related to the security and privacy of end users or websites.

8.2.4 Data calculation

Data calculation will calculate data based on the arithmetic definitions of relative statistical index. Data calculation results can be in different forms such as a table, chart or others.

8.2.5 Result storage

Result storage will store the data calculation results in the database for inquiry. The duration of data calculation result storage should be relatively long for future applications.

Appendix I

Use case: Predicting the bandwidth requirements of a website

(This appendix does not form an integral part of this Recommendation.)

The number of websites being accessed through networks and their visitors is increasing rapidly. Websites accessing the Internet have contributed to a very large volume of network traffic in telecommunication networks. They are one of important peers through which telecommunication customers communicate through telecommunication networks. At the same time, websites are also enterprise clients of telecommunication networks which require more bandwidth. To predict and meet the network bandwidth requirements of websites can improve the QoS and QoE of end users. Measuring the key statistical indicators of website traffic such as the source IP indicator, visitor indicator and page view indicator can help in predicting the network bandwidth requirements of websites. Telecommunication network operators may plan or optimize their networks based on the key statistical indicators of website traffic. Of course, when they plan their network infrastructure capacities, they need to consider other factors, for example, network operators should take into account the number of network customers and other network traffic.

Appendix II

Security and privacy consideration

(This appendix does not form an integral part of this Recommendation.)

This appendix addresses issues related to security and privacy, since the measurements discussed in this Recommendation may get visitors' private information from the traffic.

Security and privacy issues should be considered by all activities on the Internet. During the measurement for the KSIs of website traffic, some preventative measures should be taken to protect visitors and websites from security and privacy threats.

The measurement system for the KSIs of website traffic must secure the various components of the system from unauthorized access or corruption. Within the measurement procedure, steps like data acquisition, data collection and data calculation must secure authorized accesses and the integrity of the process. Reporting must be encrypted to maintain confidentiality, so that only the authorized devices can decrypt the results. To prevent the leakage of confidential as well as private information reports must also be authenticated and the results should also be held and processed securely after collection and analysis. Much of the general advice contained in section 6 of [b-IETF RFC 4656] and section 7 of [b-IETF RFC 7594] are applicable here.

Privacy should be considered by the system method as a core requirement, and the steps of data collection and data calculation should be ensured to operate in a privacy-sensitive manner by default. The privacy features should be well-defined to protect the sensitive information of visitors and websites participating in measurement and data collection procedures. So, some protective steps within each measurement step should be taken to ensure the visitors' and websites' information safety, such as to collect and store the minimal information of visitors and websites to perform the measurement. Or at the step data acquisition, any visitor's sensitive information should not be acquired, and any actions which might aggrieve the visitor's security and privacy should be avoided. At the step of data ETL, some sensitive information within the data acquired should be reduced or processed, etc.

Bibliography

[b-IETF RFC 4656] IETF RFC 4656 (2006), *A One-way Active Measurement Protocol (OWAMP).*

[b-IETF RFC 7594] IETF RFC 7594 (2015), *A Framework for Large-Scale Measurement of Broadband Performance (LMAP).*

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