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Contents

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Foreword

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Modal verbs terminology

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Executive summary

The present document addresses the issue of testing methodology for equipment and networks able to dynamically adapt performance as function of real need. In the ambit of SDN (Software Defined Networks) equipment performances such as throughput, latency, consumption, etc. may be dynamically optimized as function of real-time traffic load for instance, as an example in order to optimize operational expenditures.

In the assumption that equipment always shows constant performances, today's standardized testing procedures considers only one fixed test configuration, typically at maximum load, or at most very few steady states e.g. 100 %, 50 %, 0 % of traffic load. That is, current testing methodologies do not replicate testing conditions resembling traffic load variations as happens in real life, and equipment performances are not verified and correlated accordingly.

When it comes to Software Defined Networks and equipment able to dynamically adapt performances according to real-time needs, novel measurement methodologies should be developed to properly evaluate and characterize "load cognizant" equipment and networks. Such novel methods should be able to meaningfully resemble real life traffic load shapes, as well as to aggregate and correlate measured data also in coordination with the Network Management System and/or the Equipment Management System, properly testing and characterizing equipment performances proportionality (such as power consumption, throughput, latency, etc.), as well as the response time to States transitions and any other eventual impacts on QoS and/or on Network stability.

As an example, an Energy Aware equipment may operate in a plurality of Power Management Modes according to traffic load, while an Energy Aware Network may adjust traffic routing paths so that, when traffic level is high, higher performances are provided (e.g. an higher number of links are enabled) while when the traffic load level is reduced, performances are proportionally reduced, for instance by merging traffic to a smaller number of links so that other links can run at reduced rate or set in sleeping or power-off modes.

Main scope of this Technical Report is to start building consciousness of this new problematic, to suggest environments and conditions for properly testing such new techniques, paving the way to new series of Standard test methodologies specifically tailored to SDN.

Introduction

Implementing SDN and NFV may be slowed down by lack of proper standardization able to ensure operators that the security, resilience and availability of their networks are not impaired when virtualised network functions, software defined network topologies and/or software defined equipment performances are introduced.

As an example the ability to dynamically adapt power consumption to actual traffic load can become a key feature for the success of Software Defined Networks, by leading to consistent OPEX saving thanks to energy usage optimization while guaranteeing peak load. Whereby, coming generation of communications equipment will be designed to adapt performances and power consumption according to traffic load, while actual standard measurement procedures simply do not consider such conditions and are therefore unsuitable to determines equipment's ability to adapt performances to traffic load needs, i.e. to provide a suitable test and characterization environment for testing the dynamic response of equipment and networks to performances variations requests.

In an environment, communications equipment can operate in more than one power management mode. The power management mode determines the power consumption, and it is properly selected to optimize power consumption to real needs. The testing method herein described is aimed to closely resemble real life traffic load, and measures the response of the communications equipment to the transition event between power management modes triggered by the traffic load variations. One or more parameters can be measured, for example communications equipment performances such as data throughput, latency, loss of rate, as function of dynamic variations in traffic load, as well as characteristics such as transition timing, power consumption, etc.

Measurements taken should corresponds specifically to time periods when the communications equipment is handling the transition between traffic load levels eventually triggering transition between power management modes or other dynamic adaptation functions, or when the communications equipment is in one of the possible steady States which are dependent by the applied traffic load or by any other State transition trigger.

The testing apparatus should also determine the coordination and promptness of the dynamic response, such as for instance the ability to withstand sudden traffic ramping up, e.g. to timely wake-up from a sleeping or power-off State. Thus, the testing equipment determines the direct response of the communications equipment to a transition in level of the trigger event, e.g. traffic load, ultimately determining if the equipment under test guarantee the desired quality of service (QoS) in all the possible working conditions.

1 Scope

The present document addresses the issues of testing methodology for equipment and/or network configurations able to dynamically adapt its performance as function of a generic variable, e.g. traffic load variations, eventually under the control of a local and/or a centralized Management entity. Useful in the ambit of SDN (Software Defined Networks) and/or NFV (Network Function Virtualization) applications where network topology, equipment availability and/or performances such as throughput, latency, power consumption, jitter, etc. may be dynamically adapted as function of real-time needs, in order for instance to optimize operational expenditures.

The present document is intended as a general introduction to the issue in question, with the aim to be the basis for a family of papers dedicated to relevant applications may be developed in the future as part of SDN and/or NFV evolution. For sake of clarity the present document mainly refers to the ability to dynamically adapt power consumption to traffic load variations (hereinafter also called Energy Aware Networking), but principles herein described may be extended to test any other SDN and/or NFV application having the scope of altering network topology or equipment performances as function of a generic variable.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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Not applicable.

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Not applicable.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

energy consumption: amount of consumed energy

energy efficiency: relation between the useful output and energy consumption

node: physical representation of one or more functions