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Information Technology — Data Centres — Application Platform Energy Effectiveness (APEE)

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Foreword

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This document was prepared by ISO/IEC JTC 1, *Information technology*, Subcommittee SC 39, *Sustainability for and by Information Technology*.

Introduction

This document provides a Key Performance Indicator (KPI) for the energy effectiveness of application platform. The purpose of this KPI is to improve the energy effectiveness of application platform through the selection of an optimally energy-effective combination of IT equipment, operating system, and middleware.

The growth of Internet of Things (IoT) has resulted in the storage of increasingly large amounts of data in data centres, and the increased utilization of this data by technologies such as artificial intelligence (AI). As a result, energy consumption of data centres is also increasing. In this recent utilization of large amounts of data by technologies such as AI, various kinds of data are combined and analysed, and processing requests for such combinations and analysis are also increasing. Middleware, such as a database management system (DBMS), is also becoming more important for this data utilization. The energy effectiveness of application platform can be greatly improved through the selection of middleware.

In addition to improving the energy effectiveness of IT equipment itself, it is necessary to improve the energy effectiveness of application platform by choosing an optimally energy-effective combination of IT equipment, operating system, and middleware.

Although there are several KPIs (ISO/IEC 30134-4 IT Equipment Energy Efficiency for servers(ITEEsv), ISO/IEC 21836 Server Energy Effectiveness Metric) for the energy effectiveness of IT equipment itself, there was previously no KPI for energy effectiveness to calculate energy effectiveness of a combination of IT equipment, operating system, and middleware. This document, therefore, introduces a KPI for the energy effectiveness of an entire application platform. A typical use case of Application Platform Energy Effectiveness (APEE) is a criterion to procure an energy efficient application platform for an IT service.

This KPI provides assistance in selecting an optimal application platform for energy effectiveness. This KPI does not apply to the energy effectiveness of an entire data centre.

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Information Technology — Data Centres — Application Platform Energy Effectiveness (APEE)

1 Scope

This document specifies APEE as a Key Performance Indicator (KPI) which quantifies the energy effectiveness of an application platform for an IT service in data centres. This KPI evaluates energy consumption of application platform prior to deployment.

This document specifies a formula for APEE, and definitions of components of the formula.

This document specifies a measurement method to assess and report the energy effectiveness of an application platform.

This document specifies requirements for benchmarks to be used for APEE.

This document specifies requirements for reporting.

The following topics are outside of the scope of this project:

1) energy effectiveness KPIs for only IT equipment,

2) energy effectiveness of data centre facilities.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 30134-1:2016, *Information technology — Data centres — Key performance indicators — Part 1: Overview and general requirements*

ISO/IEC 21836, *Information technology — Data centres — Server Energy Effectiveness Metric*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 21878 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
application platform
platform composed of IT equipment, operating system, and middleware with the purpose of providing an IT service

Note 1 to entry: An application platform is an environment for executing software application such as ERP and CRM software. Therefore, software application itself is not included as part of an application platform.

3.1.2
software application
software for implementing an IT service by using an application platform

Note 1 to entry: Software application is usually developed independently for each IT service.

3.1.3
middleware
software layer between a base operating system and the software applications

Note 1 to entry: Example of middleware: DBMS, web server software, application server software, transaction monitor.

Note 2 to entry: Base operating system is the software directly managing hardware. e.g. conventional operating system, hypervisor

[SOURCE: ISO/IEC/IEEE 24765:2017, 3.2459, modified – The note 1 and the note 2 has been added.]

3.1.4
IT equipment
server, storage, and network equipment that are components of an application platform

3.1.5
IT service
service that provides a valuable outcome to its users via information technology

3.1.6
application outcome
valuable outcome provided by an IT service to its users

Note 1 to entry: Example of application outcome: a set of reports to support decision-making at retail outlets (such as sales analysis reports, and stock status reports)

3.1.7
measurement period
during which the benchmark is performing the data processing intended to be measured by the benchmark

Note 1 to entry: Typically, the measurement period(s) are the only portion of the benchmark execution which are used to calculate the benchmark score.

Note 2 to entry: In the case of using TPC-H, the measurement target of TPC-H[1] is a performance for executing SQL queries, so a period of executing SQL queries is a measurement period. Other period such as a data loading is not a measurement period.

3.1.8
benchmark identifier
string to identify a benchmark, which consists of the name and the major version if applicable

3.1.9
version
particular form or variation of a resource that differs from other instantiations of the resource in at least one aspect or item of information

[SOURCE: ISO 24619:2011, 3.1.9]

Note 1 to entry: The first digit of a version is called the major version, and any numbers right of that digit is called a minor version.

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1)   TPC-H, TPC-E, and TPCx-IoT are trademarks of the Transaction Processing Performance Council. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO/IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Note 2 to entry: Example: in the version designated as "v1.2.3," the Major Version identification is "1", and the Minor Version identification is "2.3 ".

[SOURCE: ISO/IEC 21836:2020, 3.1.59. Under preparation. Stage at the time of publication: ISO/IEC DIS 21836:2020.]

3.1.10
internal power supply
device that converts commercial AC power to the DC power as required by IT equipment

3.2 Abbreviations

AC   Alternating Current

AI   Artificial Intelligence

APEE   Application Platform Energy Effectiveness

CRM   Customer Relationship Management

DBMS   DataBase Management System

DC   Direct Current

ERP   Enterprise Resource Planning

FC   Fibre Channel

IoT   Internet of Things

OS   Operation System

RDBMS   Relational DataBase Management

4 Relevance of APEE

Many kinds of IT services are provided by using data centres, and it is necessary to conserve the amount of energy used by these IT services. Lots of IT services use various technologies, such as AI, IoT, and big data technologies. For each of these technologies, there are several combinations of IT equipment, OS, and middleware that can be used to provide IT services. These combinations of IT equipment, OS, and middleware are called application platform.

Even if the results provided by an IT service are the same, if the application platform used to provide the IT service is different, the energy consumption is also different. For example, when the same query is executed on different DBMSs, because the processing method and processing time are different for each DBMS, energy consumption also differs.

In order to choose the optimum application platform for energy effectiveness, a KPI for measuring the energy effectiveness of an application platform is necessary. There are KPIs for measuring the energy effectiveness of IT equipment only, and ISO/IEC 21836 is one of KPIs for a server. APEE is a KPI for measuring the energy effectiveness of an application platform. Use cases of APEE are described in Annex A.

NOTE   APEE is a KPI for measuring the energy effectiveness of an application platform for a particular IT service, not the energy effectiveness of an entire data centre. Therefore, APEE is not suitable for use in regulations that apply to an entire data centre.

5 Determination of APEE

APEE shall be determined and described by Formula (1):

APEE = *NoAO / EAP*   (1)

where

   NoAO   = the Number of Application Outcomes during an APEE measurement (see clause 6);

   EAP   = the Energy Consumption(kWh) of the Application platform during the measurement periods (see clause 6).

The unit dimension of APEE is (application outcome(s) / kWh). APEE value should have at least 2 significant digits.

Reporting of data for APEE is described in clause 7.

An example of APEE calculation is given in Annex B.

6 Determination of application outcome and energy consumption of the application platform for APEE

6.1 Prerequisites for benchmark and application platform

The following prerequisites shall apply when measuring the APEE of an application platform that provides an IT service:

a) The measurer determines one benchmark to be used for the calculation of APEE. Benchmarks shall meet the following requirements. Examples of benchmarks that can be used for APEE measurement are given in Annex D.

   1) The benchmark is representative of the target IT service.

   2) The start and the end of the execution of the benchmark are clear.

   3) All iterations of the benchmark run produce comparable results.

   4) An application outcome defined by the benchmark is identical regardless of how many times it is executed on any application platform.

     NOTE 1   In the case of TPC-H as an example of an application outcome, it defines a set of results of business-oriented ad-hoc queries as an application outcome of the execution. Performance metric such as throughput and processing time is not an application outcome.

     NOTE 2   For example, benchmark that executes transactions while increasing the multiplicity until the system cannot keep the specified response time in order to obtain maximum multiplicity is not applicable. Because the processes of measurement target for these benchmarks have the potential to change from run to run.

   5) Start date and time, and end date and time of all the measurement period(s) are clear.

     NOTE 1   Some benchmarks have multiple measurement periods in one benchmark execution.

     NOTE 2   Example of clarification: a benchmark records start date and time, and end date and time of each measurement period in log file.

   6) Measurement period start and stop time are measured in second or higher precision.

7) To ensure that result is verifiable, the benchmark is publicly available.

b) The measurer determines the IT equipment, OS and middleware that are to serve as the elements of the application platform. The application platform shall meet the following requirements:

1) The application platform contains all of the IT equipment necessary to execute the benchmark.

2) Each piece of IT equipment can be measured for energy consumption.

6.2 Determination of application outcome

For the determination of application outcome, the following terms are introduced:

a) One application outcome is defined as one execution of the benchmark.

The following requirements for measurement shall be met:

a) The benchmark is executed at least one time. If the benchmark is executed multiple times, the number of benchmark executions is a positive integer.

NOTE The tester may interact with the server between benchmark iterations, typically to calculate the total measured time for benchmarks which include unmeasured periods.

b) If the total time of all the measurement period is less than one hour, the benchmark is repeatedly executed until the total time of all the measurement period exceeds one hour.

6.3 Determination of energy consumption of the application platform

6.3.1 Requirements to obtain energy consumption of the application platform

Energy consumption of the application platform shall be obtained by the sum of energy consumption(kWh) of all the IT equipment in the application platform during all measurement period(s) of the APEE measurement. Execution of non-benchmark software on the application platform shall not invalidate energy results. Energy measurements during benchmark execution shall not be adjusted to remove the effects of non-benchmark software.

NOTE The application platform is usually used solely by the benchmark during the measuring period for accuracy.

Energy consumption of each IT equipment in the application platform is obtained by the measurement method. Details of this method is given in 6.3.2.

6.3.2 Requirement of method to obtain energy consumption

The measurement method shall meet following requirements. The measurer shall replace "SEEM" with "APEE" and "SUT" with "application platform" in the text of the SEEM referenced below and apply.

a) Environment

1) ISO/IEC 21836:2020, Information technology – Data centres – Server Energy Effectiveness Metric[2], 7.2 is applied for measurement environment.

2) ISO/IEC 21836:2020, Information technology – Data centres – Server Energy Effectiveness Metric[2], 7.4 is applied for power requirements.

b) Power measurement

1) One or more power analysers shall be used to measure the entire energy consumption of the application platform.

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2) Under preparation. Stage at the time of publication: ISO/IEC DIS 21836:2020.