Product-neutral tendering of notebooks

Guideline for public IT purchasing
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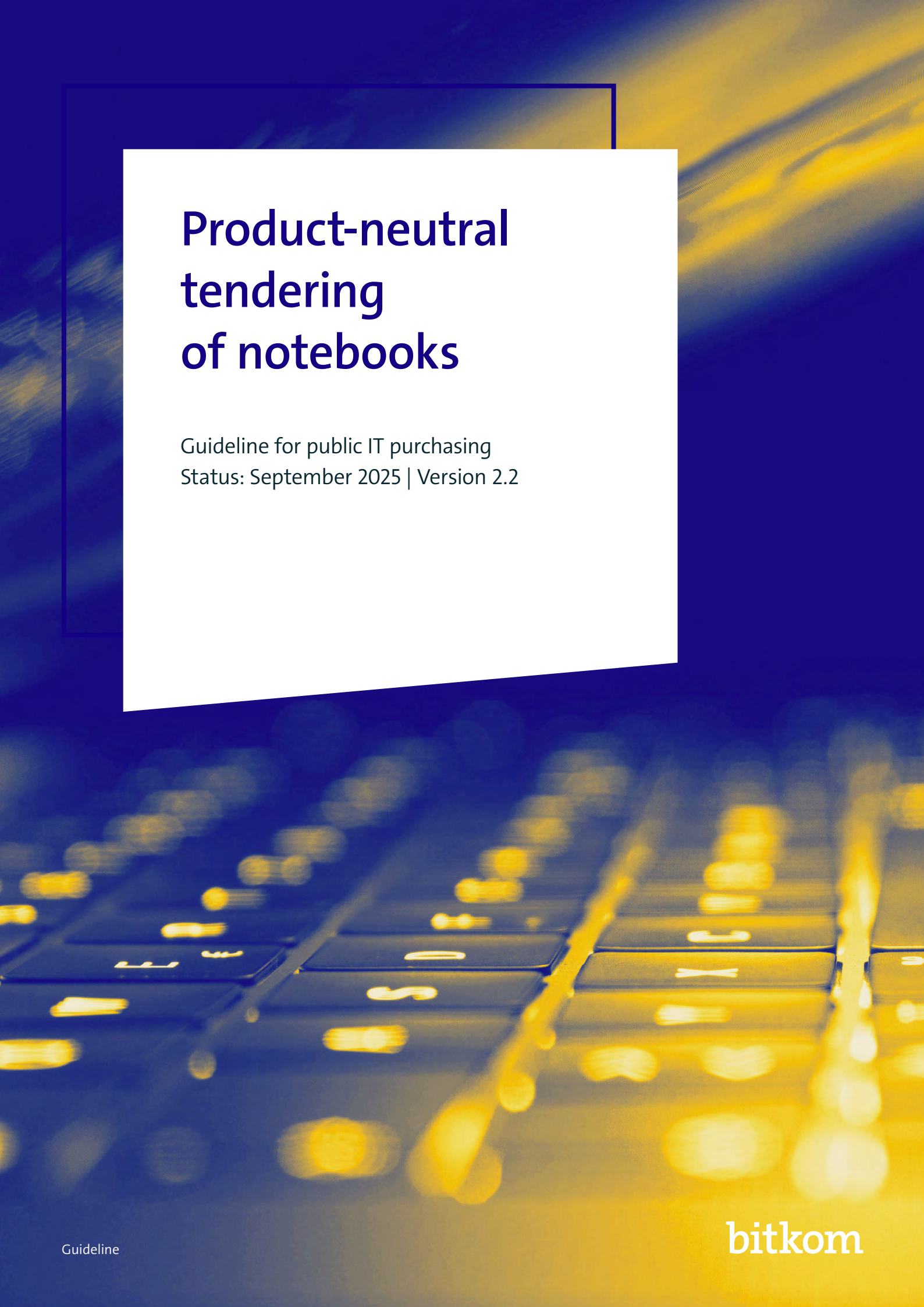

Guideline

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1 Introduction

1.1 Application of this Guideline

This Guideline provides an overview of the principles and criteria for the procurement of notebooks by public administration. The aim of the document is to provide public contracting authorities at federal, state and local level with reliable and comprehensible assistance so that they can formulate product-neutral tenders for the procurement of notebooks, that is, without using protected brand names or naming specific manufacturers, but taking current technical requirements into account.

This Guideline focuses on a list of technical criteria that can be used to describe and compare the notebooks themselves and the requirements for their operating environment and other features. However, it is important to note that the technical criteria listed are subject to constant change and must be weighted differently depending on the planned area in which the devices for procurement will be used. The higher the demands placed on the product, the higher the offer price will tend to be, which may further restrict the product range available on the market. For this reason alone, this Guideline cannot replace professional considerations and weighting of the respective criteria to reflect your own needs.

However, the authors of this Guideline would also like to support procuring authorities in public administration by drawing particular attention to sensitive criteria and requirements, that is, those which may lead to market restrictions, and to cost-relevant decisions. The icons defined below are used for this purpose: The third icon is not included in this Guideline. It is listed nonetheless for the sake of uniformity[1] in this Guideline.

Icon	Meaning
	The requirement of criteria bearing this symbol may lead to cost increases and/or market restrictions.
	This icon indicates the correction of a common error or points to particularly important statements in the text.
	This icon indicates whether certificates can be used to verify criteria.

1 Cf., e.g., the ↗ Guideline for the product-neutral tendering of multifunctional devices

1.2 Product neutrality as a legal requirement

Under public procurement law, there is an obligation to ensure the equal treatment of suppliers and products offered. The legal basis requires a description of the procurement item according to objective and non-discriminatory criteria, that is, a product-neutral performance specifications (cf. Section 97 (2) GWB and Section 31 (6) VgV for EU-wide award procedures as well as Section 55 (1) BHO and Section 2 (2) UVgO for sub-threshold awards).[2] Certain product designations or brand names may only be used in invitations to tender in justified exceptional cases if a sufficiently precise description is not possible by means of customary designations or general criteria.

However, product-neutral tenders can also be viewed as an opportunity. This is because they ensure fair and open competition, prevent technical predetermination and the resulting risk of lock-in effects. The number of competing suppliers increases if procurement is based solely on general, factual and technical criteria. This improves the choice and savings potential in procurement processes, as well as the exploitation of market opportunities by changing suppliers without significant difficulties.

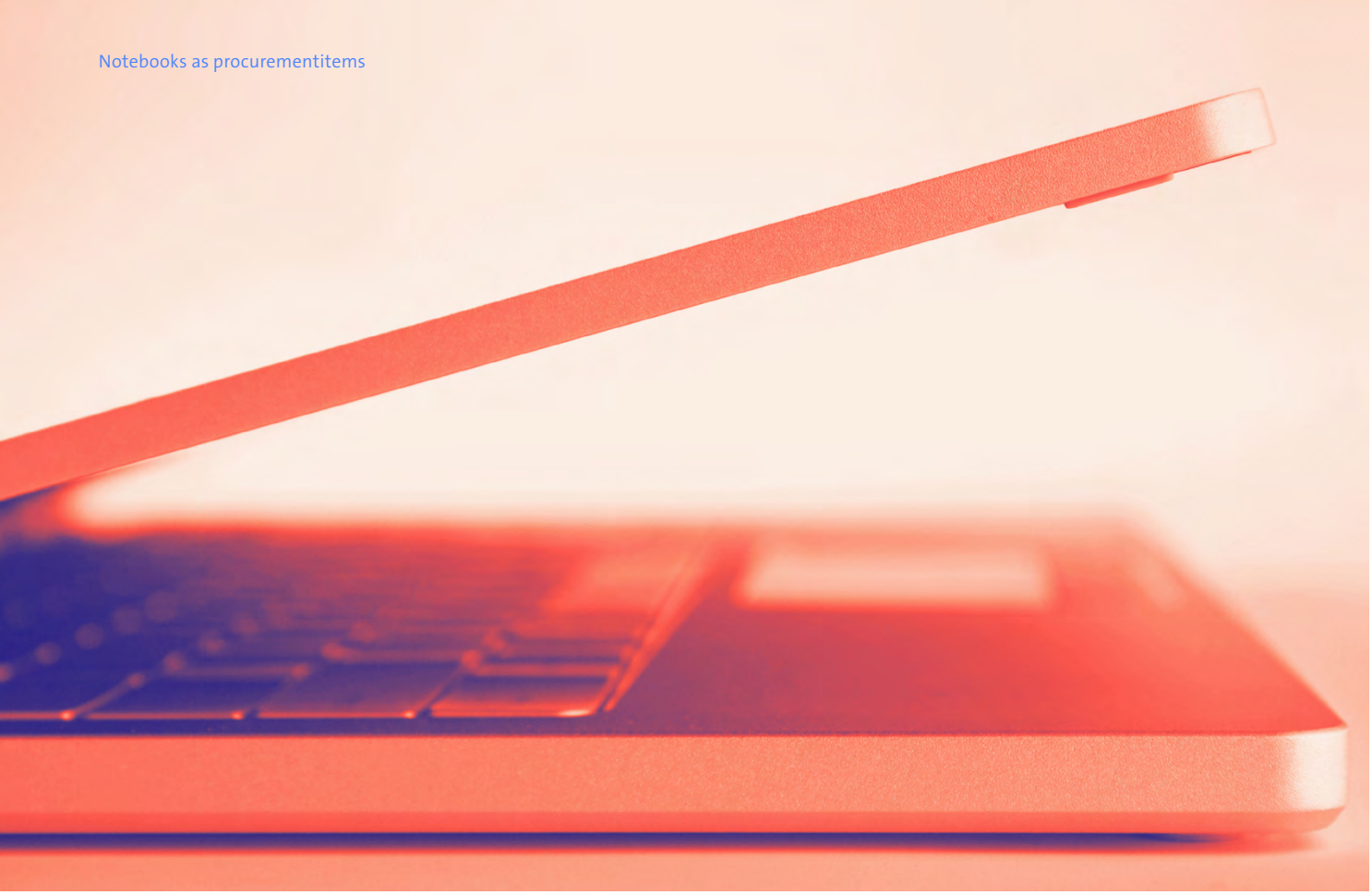
In the case of public tenders, the awarding authority is also required to establish criteria for the procurement product that enable comparison between different bids and hence ensure sufficient differentiation. It is at the discretion of the procuring authority to decide on the criteria it will use to select the goods or services for procurement, but the award criteria must be needs-based, product-neutral and transparent.

However, organizing a product-neutral tender is no easy task, particularly in the area of IT product procurement, and is often associated with considerable uncertainty for the public authorities concerned. Major challenges that public procurers must overcome include the technical complexity of the subject matter, the rapid succession of product cycles and, above all, the difficulty of estimating and precisely describing the desired performance of a system, taking into account all technical requirements.

This is precisely where this Guideline steps in, providing compact assistance to support compliance with legal requirements in the wording of technical specifications and to hence ensure fair competition. The Guideline names and explains current technical standards that enable notebooks to be described according to general technical characteristics.

2 Article 42(4) of Directive 2014/24/EU of 26 February 2014 also clearly formulates this principle: »Unless justified by the subject-matter of the contract, technical specifications shall not refer to a specific make or source or to a particular process characterizing the goods or services provided by a specific economic operator, or to trade marks, patents, types, a specific origin or a specific production, if this Favors or excludes certain undertakings or certain goods.

The use of generally recognized benchmark procedures as an essential component of product-neutral performance specifications is used here. The product features and technical requirements are presented in a compact tabular form. There are plans to update the Guideline at regular intervals to ensure its currency. New technical developments are taken into account and the proposed benchmark values are adapted to the current state of the art.



2 Notebooks as procurement items

2.1 Benchmarks for evaluating the procurement item

As computer technology continues to develop, it has become increasingly difficult to compare the performance of individual computer systems solely on the basis of their technical specifications. For example, a processor with a higher clock frequency does not necessarily deliver more computing power. Tests known as benchmarks have been developed in order to better compare performance, as the clock frequency alone is no longer sufficient to compare the performance of different processors and the products of different manufacturers with different internal architectures.

Benchmarks can be used to measure the performance of notebooks from a functional perspective. Benchmarks are programs that measure the overall performance of a system or individual components such as the graphics unit, RAM, hard disk or similar. The benchmark program performs a series of standardized tests that simulate specific tasks typical for the application and then generates a score for the performance of this system. This measured value reflects the current system performance for the measured application and hence enables objective, data-

based comparability. The benchmark should be recognized by all competitors (e.g. hardware manufacturers)
and have been developed by independent industry consortia or software manufacturers. The advantage of these benchmarks is that they provide a standardized,
reproducible method for objectively measuring the performance of a notebook that is geared towards the comparability of different system architectures.

Benchmarks usually require annual updates to reflect the rapid development of notebook technology, the underlying microprocessor architectures and the application software.

2.1.1 Benchmark overview

In view of the many different benchmark programs, it is not always easy for the procuring authority to determine the most suitable benchmark(s) for its tender. If the procuring authority selects an inappropriate benchmark, there is a risk of procuring notebook systems that are not suitable for the user and of excluding suitable suppliers from the award procedure in a discriminatory manner.

Regardless of which benchmarks are used by the awarding authority, it is essential to ensure that the underlying benchmark follows a coherent methodology and yields reproducible results. Deviations from the methodology can lead to unreliable and incomparable measurement results. It may also lead to a reprimand in the award procedure.

There are basically two different types of benchmarks:

- System benchmarks use a defined use case to measure the overall performance and battery life of a notebook system.
- Component benchmarks measure the performance of individual components, such as the CPU (Central Processing Unit), memory, graphics unit, etc.

Irrespective of this distinction, a benchmark must:

- Measure the overall performance of the system and not just the performance of individual components; in doing so, it does not disproportionately weight individual components.
- Test scenarios that are geared towards the intended use. In the case of this Guideline for notebooks, this means applications from typical office environments.
- Represent all relevant manufacturers and notebook platforms; its development process is independent and transparent.

- Reflect in a balanced manner the expected performance during the service life of the PC.
- Be relevant and representative: Awarding authorities should select benchmarks that reflect the intended use of the systems for procurement.

- Be up to date: Awarding authorities should always use the version recommended in this Guideline.

Awarding authorities should choose benchmarks that have been developed by recognized standardization bodies in an independent, transparent and fair development process involving as many relevant stakeholders as possible.

Good benchmarks are updated continuously and new benchmarks are regularly introduced to keep pace with the rapid evolution and innovations in the notebook industry. Using a benchmark that is not up-to-date to compare the performance of two notebook systems may produce distorted results. For example, a notebook system that uses a new technology to improve performance would be at a disadvantage if a benchmark is used for comparison that does not consider and measure this new technology. In this example, the system with the legacy technology might achieve a higher (better) result than the newer system with the improved, faster technology. In short: Outdated benchmarks may place new, innovative and more powerful products at a disadvantage. In addition to the currency of the benchmark software, it is also important to ensure that the operating system used for the measurement is up-to-date.

When using benchmarks, it is also important to pay attention to compatibility in relation to the chipset architecture (x86, ARM) in order to obtain a representative result. Not all currently available benchmarks and possibly also the specialist applications used later on are available as native ARM versions, which means they must be emulated when used on systems with ARM chipsets. In most cases, this leads to lower (worse) results than when using the native ARM version of the benchmark and may make direct comparison with results on x86 systems more difficult.

2.1.2 Benchmark developers

- Benchmark developers can be categorized according to the following criteria:
- Non-profit benchmark consortia (e.g. BAPCo®, SPEC® and EEMBC®)
- Non-profit open source benchmarks (e.g. Principled Technologies®)
- Independent commercial benchmark developers (e.g. Futuremark® (UL Benchmarks) and Kishonti® Informatics)
- Smaller commercial developers (e.g. AnTuTu®)

2.1.3 Benchmark recommendations

This Guideline recommends the following benchmarks as they fulfil the above-mentioned requirements for a benchmark and enable a meaningful comparison of notebooks in an office environment:

- SYSmark 30 Overall Value
- PCMark 10 Standard Score
- Crossmark
- Procyon
- MobileMark 30

More specialized application scenarios (e.g. CAD workstations) may also require more specialized benchmarks.

2.1.4 Benchmark description

SYSMark is a benchmark by the BAPCo* consortium to determine the performance of Windows PC platforms. SYSmark* tests the performance with application scenarios and offers an additional power consumption measurement for the performance test. SYSmark* contains applications in various scenarios from software developers such as Microsoft (Office 2021)*, Google* and Adobe (Acrobat, Lightroom, Photoshop)*.[3] The application scenarios in the latest version are divided into »Office Applications«, »General Productivity«, »Photo Editing« and »Adv. Content Creation« and summarized in an »Overall« score, but the individual results are also documented (higher performance values are better). Supported operating systems: 64-bit Microsoft* Windows* 11.

BAPCo releases new versions of the SYSMark benchmark software at regular intervals; these have different requirements and performance values. The values are not mutually comparable! At the time of publication, the latest benchmark version was SYSMark30

PCMark(R) 10 Benchmark is a benchmark from UL that measures the performance of Windows PC platforms and the battery life of notebooks. The PCMark(R) 10 benchmark measures the performance of the system in three groups: Essential, Productivity and Digital Content Creation. The tests involve running office applications such as writing documents, browsing the internet, creating spreadsheets and using video conferencing calls. The editing of images and videos as well as rendering and visualization are also tested. PCMark* 10 includes the LibreOffice Calc and Writer applications from the Document Foundation as well as custom applications created with standard tools from Microsoft* and the Microsoft Media Foundation*.[4]

3 A complete list of all applications, weightings, overviews of sensitivity and benchmark methodology is contained for the respective versions under Documentation in the BAPCo white paper. Published test results are available on the BAPCo website under »Results«(www.Bapco.com).

4 A complete list of all applications, weightings and the benchmark methodology is found in the »Technical Guide« for PCMark* 10. Published test results can be viewed on the UL benchmark website (https://benchmarks.ul.com/).

PCMark(R) 10 determines an overall result as well as a value for each use case (higher values are better). Supported operating systems: Microsoft* Windows* 11

Benchmark values for Windows can be used as a first point of reference if devices are to be run on an operating system other than Microsoft Windows
(e.g. Linux or Mac OS X), but it seems advisable to use a separate benchmark for the operating system used in each case.

CrossMark® from BAPCo is a benchmark for different operating systems (Windows 11, ARM, Android, iOS and macOS) that determines system performance and system responsiveness. This test uses models of well-known applications and generates values for Productivity, Creativity and Responsiveness. CrossMark enables comparisons of different operating systems. To learn more, visit ↗ www.Bapco.com/products/crossmark.

Procyon: The Procyon benchmark method is a test suite developed by UL that primarily evaluates the performance of modern computer hardware under realistic conditions. Unlike synthetic benchmarks, Procyon focuses on realistic workloads from areas such as office productivity, image and video editing or AI applications.

MobileMark is a benchmark from the BAPCo* consortium that measures battery life under Windows*. MobileMark* tests use cases during battery discharge. The results indicate battery life and a performance value (higher is better). The overall result comprises partial results for each scenario. MobileMark* contains applications like the related performance test SYSMark.

Benchmark version	The respective main versions of the PCMark 10 and Sysmark 30 benchmarks are recommended at the time of publication of this Guideline (PCMark 10 version 1.x.xxxx and Sysmark 30 version 1.x.x.xx). According to the benchmark developers, all results of this main version should be mutually comparable. The available patches merely improve compatibility and stability with newer operating system versions. Hence it is not absolutely necessary to define these sub-versions. Should a specification nevertheless be necessary due to deviating findings, the tender documents must specify the exact version to be used.	Optional

2.2 Recommendations for setting up the systems

In order to ensure the comparability of the benchmark results for different tenders, the awarding authority should stipulate certain minimum requirements for setting up the systems in the tender documents. This applies both to cases in which the awarding authority itself carries out or commissions benchmarks and to cases in which it requires bidders to provide evidence of benchmark tests.

An overview of the required, recommended and optional parameters is shown below:

Parameters	Description	Classification
Installation procedure	It is strongly recommended to perform a new installation of the operating system and not to use an image installation. This is due to some operating system features, such as super/prefetch, which can make it difficult to compare the results of images. It is also expected that the operating system's respective default settings are used during installation. In addition, the operating system should be installed in offline mode (otherwise daily updates are installed automatically, making comparability more difficult).	Required
Operating system	Under no circumstances should benchmark results from Windows 10 be compared with results from Windows 11 or Linux. It is recommended to use the latest version of the operating system (incl. build version). Past experience has shown that different versions of the same operating system produce different benchmark results.	Required
Operating system – Maintenance	It is strongly recommended to include the performance of automatic operating system maintenance after installation as a required item in the tender documents. If the benchmark starts directly after installation, the result may be falsified by the maintenance running in the background.	Required 
Operating system – Changing settings	It is recommended to prohibit any changes to the operating system settings (which are not absolutely required by the benchmark). An unbiased user of the benchmark should be able to reproduce the benchmark without specialist knowledge or explanations. The selected energy saving plan during use is an exception to this rule. It is recommended to use the maximum performance plan to minimize fluctuations.	Recommended
Operating system – Automatic updates	It is recommended to deactivate the automatic updates of the operating system or to benchmark the test system generally without connection to the internet, only with the specified updates. Allowing automatic updates can lead to different software versions and hence make the comparability process more difficult.	Recommended
BIOS delivery settings	Some BIOS settings can have a significant impact on the benchmark results and it is recommended to use the configured options when the device is delivered.	Recommended
BIOS version	It is recommended to use the manufacturer's latest BIOS version.	Recommended
Driver versions	It is recommended that the latest driver package from the system manufacturer is used.	Recommended 
Battery calibration/ battery status/brightness	Before starting a benchmark, the battery should be charged and discharged 4 – 5 times in order to achieve consistent results. PCMARK10 (UL) (Modern Office Battery life) and MobileMark (BAPCo) are available to measure the battery life. The two battery life measurements are not mutually comparable, as the two manufacturers use different recommended test methods. Comparability is only possible for PCMARK10 Modern Office Battery Life results or for MobileMark results. The tests should be performed according to the manufacturer's recommendations. Please note that the brightness has a significant effect on the battery life and that the battery life will decrease as the monitor brightness setting increases.	Recommended

Parameters	Description	Classification
Operating system – Cumulative updates	In addition to the release version of the operating system, cumulative monthly updates may also influence the benchmark results. However, this is usually not so serious. In order to maintain comparability with older benchmark results, it usually makes more sense to specify the release version. However, if a specific update version is required, it makes sense to specify the exact name – KB number (for Windows) – of the update package to be used, e.g. Windows 10 1709 KB4090913 (so that Spectre/Meltdown patches are included).	Optional
Operating system – Security updates	As security updates can have a measurable impact on the performance of the system, it is also important to ensure that the corresponding measurements are carried out for all systems with the same security update release. Furthermore, it is essential to ensure that the individual security functions and settings of the operating system used correspond to the delivery status provided by the operating system manufacturer in order to prevent unfair benchmark advantages due to the deactivation of security functions. Here, too, it is recommended to specify the exact KB numbers (for Windows) of the security updates to be used.	Optional
Number of benchmark runs	When carrying out benchmark tests, it must be assumed that fluctuations in the range of 2 – 5 % may occur in each test run for all values included in the test. Multiple measurements provide greater accuracy. However, a single run has proven to be sufficiently reliable for the benchmarks recommended in this Guideline. However, if several runs are required, this must be stated in the tender documents. Experience has shown that more than three runs are not necessary. In this case, it is also necessary to specify which calculation will be used to determine the final value (e.g. arithmetic mean), if this is not already performed automatically by the benchmark manufacturer.	Optional
Resolution	It is recommended to run the benchmarks in the current standard resolution of 1920x1080 (FHD). Internal measurements have not revealed any significant differences between lower and slightly higher resolutions. A deviation from this resolution should only be considered if ≥4k monitors are primarily used.	Optional
Additional programs	Some manufacturers offer programs that can positively influence system performance by adjusting certain BIOS and/or operating system settings. This may also influence the benchmark score, depending on the software used in the benchmark program. It is at the discretion of the awarding authority to decide whether such products are permitted. If they are permitted, it is recommended to stipulate that the software used must be offered directly by the system manufacturer, available free of charge or already included in the bid price.	Optional
Operating system language version	There are currently no performance differences between the English and German language versions of the operating system.	Optional
Benchmark version	The respective main versions of the PCMark 10 and Sysmark 2018 benchmarks are recommended (PCMark10 version 1.x.xxxx and Sysmark 2018 version 1.x.x.xx) at the time of publication of this Guideline. According to the benchmark developers, all results of this main version should be mutually comparable. The available patches merely improve compatibility and stability with newer operating system versions. Hence it is not absolutely necessary to define these sub-versions. Should a specification nevertheless be necessary due to deviating findings, the tender documents must specify the exact version to be used.	Optional
Operating system language version	There are currently no performance differences between the English and German language versions of the operating system.	Optional

2.3 Notes on benchmark implementation

This Guideline recommends that the tender documents specify exactly how the benchmarks are to be performed or alternatively refer to this chapter.

2.3.1 Settings

In addition to the basic settings of the reference system, operating systems offer many setting options that may produce significantly different results. It is advisable to create a log of the settings used if settings go beyond the recommendations in the previous section and the default settings of the operating system. This log must be submitted with the tender documents. In order to achieve comparable results, it is necessary to strictly adhere to the specified procedure for the performance of benchmarks

2.3.2 Benchmark implementation – Checklist

These implementation instructions are based on the principle that a user who complies with all the parameters prescribed by the awarding authority, but has no other technical knowledge, must be able to reproduce the benchmark result. No changes to the operating system and the BIOS that would require further explanation are permitted, unless expressly permitted or absolutely necessary to perform the benchmark.

Unless otherwise specified by the awarding authority, the following steps must be performed in the specified sequence in order to obtain a reproducible benchmark:

1. Updating the BIOS to the current version and restoring the BIOS to the factory settings.
2. Complete offline reinstallation of the specified operating system version (incl. BUILD number) with default settings from the original source of the operating system manufacturer.
3. Installation of all current drivers provided by the manufacturer. The Device Manager can be used (no yellow exclamation marks) to ensure that all drivers are installed and all devices are listed (without error messages).
4. Installation of the specified benchmark software including updates with default settings.
5. Performance and completion of a disk cleanup (HDD), trim (SSD), defragmentation and automatic maintenance.
6. Start the respective benchmark software with the standard settings specified by the benchmark manufacturer.
7. The results should be saved in the form of reports after performing the benchmark (PDF format).

The Appendix contains a detailed description of how to perform benchmarks.

2.4 Commercial models of procurement

Notebooks can be procured by renting, buying or leasing. Unlike renting, a procuring authority opting for leasing is usually given an option to purchase the leased asset at the end of the contractual useful life. Which approach the procuring authority chooses depends not least on whether a one-time budget or one extending over several years is available.

As a rule, the decision in favor of one of the procurement models mentioned must be made in advance of the procurement measure as part of a profitability analysis. A decision must also be made as to whether hardware and operating system should be purchased from a single source on a uniform contractual basis (bundling) or from different providers. Software manufacturers sometimes offer special license models for software for use in public administration.

According to income tax regulations, a normal useful life of three years is recognized for notebooks.[5] The guideline on the useful life, disposal and recycling of IT devices and software[6] also stipulates a minimum useful life of 3 years for notebooks in public administration. The procurement calculation can therefore be based on this useful life.[7]

Turnover tax is one quite significant consequence of the choice of procurement model. In the case of rentals, turnover tax is charged on the respective rental instalments and must be paid together with the rental instalments. In the case of purchase, the full turnover tax is due upon delivery (= transfer of the device to the procuring authority). The total turnover tax is also incurred upon delivery of the device if, according to the contract, ownership of the device will only be transferred after several instalments have been paid. If the transfer of ownership in an instalment plan depends on the exercise of a purchase option,
turnover tax is payable on the entire price of the device if the option is exercised in accordance with the contract. If rental instalments have already been paid before the option is exercised,
the turnover tax payments incurred on these must be reversed if the rental instalments are offset against the purchase price. In the case of leasing, turnover tax is incurred at the time at which the leased device is attributable to the procuring authority in accordance with tax regulations.[8]

5 Cf. ↗ Depreciation table of the Federal Ministry of Finance for generally usable fixed assets
6 Cf. ↗ IT Council Decision 2013/07
7 However, the Federal Environment Agency points out in a position paper from June 2016 that a short calculated useful life with an observation period of 10 years leads to higher life cycle costs and higher external costs (e.g. costs due to greenhouse gas emissions).
8 Cf. the comments of the tax authorities on these turnover tax consequences in Sub-section 3.5 (5) and (6) of the German Turnover Tax Application Decree (UStAE).

	Purchase contract	Rental agreement	Leasing contract (financing)
Hardware ownership	Procuring authority	Contractor	Contractor, usually with option to transfer ownership to the procuring authority
Services (establishing and restoring operational readiness)	▪ Typically the responsibility of the contracting authority ▪ May be awarded additionally, regardless of the seller	Should be agreed and owed by the contractor.	Typically the responsibility of the contracting authority
Operating system bundling (pay attention to the license model)	Can/should be agreed if services are provided	Should	Can
Burden on budgetary funds/ budget	Significant one-time burden	Evenly distributed burden over the term of the contract	Average one-time charge (deposit payment), then evenly distributed charge over the term of the contract, followed by average one-time charge when the purchase option is exercised or compensation payment based on the residual value

Table 1: Commercial models of procurement

2.5 Services

The provider's service portfolio does not have to be limited to the delivery of hardware and software, but may also include other services related to the delivery item. For example, an bid could be submitted to maintain the hardware and any software supplied and keep them up to date on the basis of a separate service contract or via a warranty extension. Furthermore, additional services such as troubleshooting or hotline services can be commissioned in addition to just hardware or software procurement.

If necessary, the corresponding support should be agreed with the specification of response times/repair times.

Customary market offers differ according to:

- Duration of the contract
- Response times (time between fault report and first support response)
- Recovery time (time between reporting a fault and restoring the system's operational readiness)
- Spare parts logistics
- Additional technical services offered (billing based on hourly rates and travel expenses).

Requirements can be as needed:

- 3, 4 or 5 years of on-site service
- On-site service with a response time of x hours. The customary response time is one hour (may also be an auto-response) within normal office hours (e.g. 8 AM to 5 PM). Otherwise on the next working day.
- On-site service with a recovery time of x hours (type and scope depend on the intended use. Lower surcharge for a recovery time of two working days, shorter times are possible but will affect the pricing).

- Availability of the German-speaking hotline for x hours on y days/week
- Spare parts delivery without replacement by the service technician
- Spare parts stock held by the customer
- After receiving a replacement data carrier, the contracting authority should be able to destroy defective data carriers without returning them (depending on security requirements).

Individual agreements can be made as part of the procurement of high-availability or security-relevant solutions. In this case, a balance must be struck between the necessity of the requirements and the resulting costs.

For example, the following additional specifications can be defined if necessary for the procurement of notebooks:[9]

- Maximum delivery time
- Free delivery
- International delivery
- Delivery to multiple locations
- Delivery to individual rooms
- Pre-installation of the operating system required
- Pre-installation of additional software
- Creation of backup copies of the operating system required.

9 The delivery details can be linked to standards in the tender, e.g. DAP/DPU in accordance with Incoterms (↗ https://www.freightos.com/de/freight-resources/incoterms-plain-english-freight-shipping-guide/).

3 Performance values and battery life

The following table compares performance requirements and battery life, broken down according to benchmark method.[10]

3.1 Mobility classes

A notebook's suitability for mobile use largely depends on its weight and battery life. Battery capacity influences the battery life. Longer lives generally lead to a higher weight.

Benchmark	Recommendation – Minimum values
SYSmark® 30 Overall Value (at least 16 GB RAM required)	At least 1100 points (for all mobility classes)
PCMark 10 Standard Score	At least 5600 points (for all mobility classes)
Crossmark	At least 1400 points (for all mobility classes)
Procyon	At least 5800 points (for all mobility classes)
MobileMark 30 (battery life in min.)	At least 340 min. (longer battery lives are recommended, especially for frequent travel)

Table 2: Performance requirements and battery life

Notes:

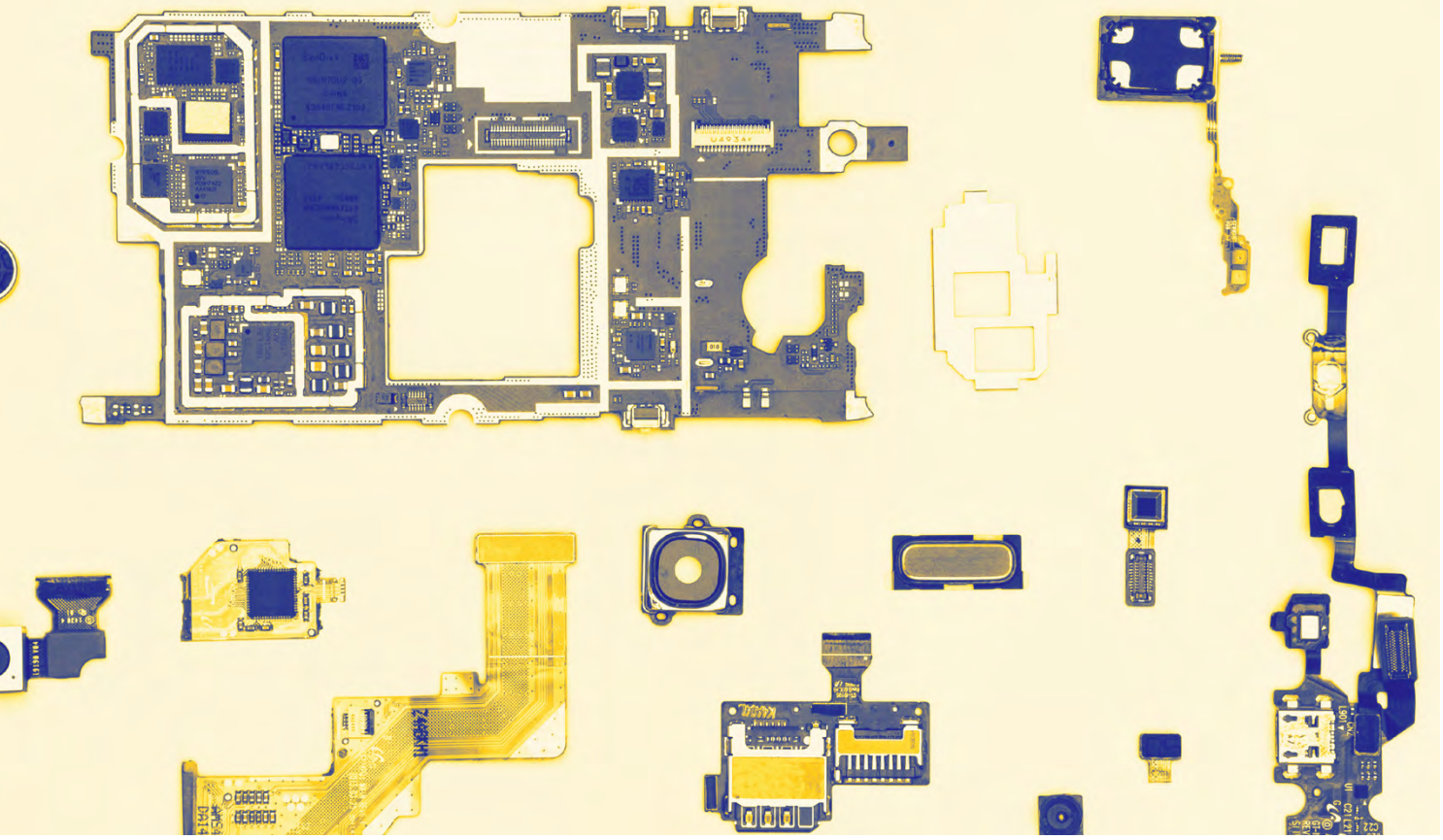
Tested hardware in 16GB dual-channel memory expansion:

- Core Ultra 5 125U
- Core Ultra 7 155U
- Ryzen 5 Pro 8540U
- Ryzen 7-7730U
- Snapdragon X1P 42100
- Snapdragon X1 24100

Many devices will have higher benchmark values than the minimum values suggested here. However, the value thresholds should also cover low-cost devices (e.g. for schools or simple workstations), as well as the single-channel configurations that are still commonly used.

10 Representatives from AMD, Intel and Qualcomm, among others, were involved in the development of the benchmark recommendations. Of the benchmarks, the Sysmark 30 and Mobilemark 30 benchmarks are not supported on devices with Windows on ARM as the operating system (as of August 2025). But this may change going forward. Furthermore, this Guideline does not contain any recommendations for Sysmark 25 and Mobilemark 25 (end of life). Recommendations for these two benchmarks are included in the previous versions of this Guideline.

> In addition to the display, the number of active cores and the frequency of the CPU/APU in battery mode both have a significant influence on the battery life. Depending on the system configuration, the performance values can therefore be reduced in favor of a longer battery life. Battery life measurements should be carried out in »Better Battery Mode« (»more battery efficiency« mode).



4 Technical criteria and requirements

The tendering authority must use general characteristics to describe the procurement item to enable a comparison between the bids received in response.
This Guideline lists various criteria in tabular form that are suitable as parameters for the description of notebooks. Technical requirements are assigned to the criteria in order to make these parameters assessable and comparable. Minimum requirements add up to a standard that can be expected according to the current state of the art, is achieved by all newer devices currently available on the market and should not be undercut in tenders. The last column provides further information and clarifications concerning the technical requirements.

In addition to the minimum requirements recommended here, further requirements may be formulated as part of weighted evaluation criteria. The contracting authority may also define further criteria and additional requirements in the tender documents if it has special requirements for the procurement item. Certain requirements are particularly relevant for notebooks. Their respective technical aspects are considered in detail hereinafter.

4.1 Processor, memory and optical drives

No.	Criterion	Requirements	Suitable as	Remarks
1	**Processor type (CPU)**	x86, ARM/multi-core architecture	Minimum requirement	Cf. Remarks on the processor type when using specialist applications or benchmark procedures (↗Chapter 2.1.1) 
2	**Random access memory (RAM)**	▪ 16 GB ▪ From DDR 4 and LPDDR4	Minimum requirement	Prospective development towards DDR5. LPDDR memory cannot be socketed. 
3	**Mass storage**	Design: M.2 or 2.5 inch/240 GB SSD (SATA III/NVMe)	Minimum requirement	

Table 3: Criteria and requirements in regard to the processor, memory and optical drives

4.2 Graphics unit

Criterion	Requirements	Suitable as	Remarks
Graphics unit	▪ Integrated in the CPU ▪ DirectX 12-capable	Minimum requirement	The graphics unit is located in the CPU/ APU.
	▪ Discrete ▪ DirectX 12-capable	Evaluation criterion	The graphics unit is located as a separate unit on the motherboard. For mobile workstations, e.g. CAD/CAM workplaces 

Table 4: Criterion and requirements in regard to the graphics unit

4.3 Display

No.	Criterion	Requirements	Suitable as	Remarks
1	**Aspect ratio/display resolution**	16:9 or 16:10, at least Full HD	Minimum requirement	Some 1920 x 1200 pixels (WUXGA) are now also available on the market. These should be rated as at least equivalent to Full HD.
	More than Full HD	Evaluation criterion	Font and symbol sizes can be adjusted in the operating system if necessary.
2	**Anti-reflective coating**	Non-reflective (non-glare)	Minimum requirement	Adherence to anti-glare display with touch functionality will lead to market restrictions. 
3	**Viewing angle**	▪ At least +/- 85 degrees horizontally and vertically	Minimum requirement	Wide Viewing Angle (WVA) display
			-or-	
	▪ At least +/- 40 degrees horizontally, +10/- 30 degrees vertically	Minimum requirement	E.g. TN display Information in this regard in the panel data sheet

No.	Criterion	Requirements	Suitable as	Remarks
4	**Luminosity**	200 cd/sqm	Minimum requirement	Using higher luminosity generally increases energy consumption; currently available approx. 200 cd/sqm – approx. 1000 cd/sqm
5	**Contrast ratio (static)**	300:1	Minimum requirement	Currently available approx. 200:1 – approx. 1500:1. Typical values are, e.g.: ▪ from 500:1 (with WVA panel) ▪ from 300:1 (with TN panel)

Table 5: Criteria and requirements in regard to the display

4.4 Network connections

No.	Criterion	Requirements	Suitable as	Remarks
1	**Ethernet**	RJ 45 Ethernet 10/100/1000 Mbit, can be fulfilled with adapter	Minimum requirement	The design of small and thin notebooks in particular often do not include an RJ-45 interface, so a suitable adapter should be considered equivalent.
		Native interface, no adapter solution	Evaluation criterion	
		WOL/PXE 2.x	Minimum requirement	WOL should also be possible from the energy-saving states S4 and S5
2	**Wi-Fi**	Wi-Fi according to IEEE 802.11ac (Wi-Fi 5)	Minimum requirement	Going forward, tendency towards newer version 802.11ax (Wifi 6E)
3	**Bluetooth**	Version 5.x	Minimum requirement	The Wi-Fi/Bluetooth modules are usually combined modules.
			Evaluation criterion	It must be possible to switch off Bluetooth and Wi-Fi separately.
4	**WWAN**	4G LTE (integrated), data transfer rate >= 100 Mbit/s for download and >= 50 Mbit/s for upload	Minimum requirement *-or-* Evaluation criterion €	Higher data transfer rates are available on the market. Upgrading or converting from 4G/LTE to 5G is not technically possible. If the introduction of 5G as a standard is envisaged moving forward, this must already included in the preparations when the devices are procured.

Table 6: Criteria and requirements in regard to network connections

4.5 Interfaces/features

No.	Criterion	Requirements	Suitable as	Remarks
1	**USB**	2 x USB 3.x, of which at least 1x type A and 1x USB-C, or adapter solution to provide type A.	Minimum requirement	Please note that if one of the USB type C interfaces is also used to charge the notebook, it is occupied during the charging process and cannot be used to connect other peripherals. If USB type A is not available, an enclosed adapter from USB-C to USB-A should also meet the requirement.
2	**Display output**	1 digital connection for screens	Minimum requirement	The exact type should be specified (e.g. HDMI or DisplayPort). Adapters should be permitted in order to ensure broad competition.
3	**Audio**	Audio-in & audio-out	Minimum requirement	A combined interface also meets the requirement
4	**Keyboard**	▪ German keyboard layout ▪ Backlit keyboard	Minimum requirement Evaluation criterion	Separate numeric keypad unusual for models smaller than 15 inches.
5	**Front camera**	Resolution 720p HD	Minimum requirement	Extended requirements for the camera functionality (infrared camera) when using Windows Hello.
6	**Smartcard reader**	Security class 1, card format: ID1 (85.60 mm × 53.98 mm)	Evaluation criterion	Not available in every height and no longer standard on the market, but can be used as an evaluation criterion. External solutions should also be permitted here, especially for small, slim devices.
7	**SD card reader**	SD version >=3.0	Evaluation criterion	Not available in every height and no longer standard on the market, but can be used as an evaluation criterion. External solutions should also be permitted here, especially for small, slim devices.
8	**Biometric sensor**	▪ Fingerprint sensor ▪ Infrared webcam	Evaluation criterion Evaluation criterion	
9	**Loudspeaker** **Microphone**	Stereo Mono	Minimum requirement Minimum requirement	
10	**Touchpad**	Two-button function	Minimum requirement	

Table 7: Criteria and requirements in regard to interfaces/features

4.6 Docking functionality

The manufacturer's designation for a docking station is not standardized. Names such as port replicator, travel dock or mini dock are also used, depending on the manufacturer. The connection to the docking station is made either via a manufacturer-specific (proprietary) interface or via USB-C (universal/is the current industry standard). The docking interface used largely determines the number and speed of the connections provided and whether or not the notebook can be charged via the docking station. Docking stations can also be distinguished according to their functionalities. Docking stations with a universal connection may also have additional manufacturer-specific functionalities, which can be proprietary or universal. They are marked accordingly in Table 10.

No.	Criterion	Requirements	Suitable as	Remarks
1	**Docking connection**	▪ Universal docking connection (USB-C) *-or-* ▪ Proprietary (mechanical) docking connector	Minimum requirement	Basic functionalities via USB-C do not usually depend on the end device. Special functional requirements (e.g: MAC address passthrough, switching on via docking, ...) often only work with the original docking stations from the respective device manufacturer. There are now solutions on the market without a proprietary docking connector.
2	**Docking functionality**	▪ Charging function ▪ Universal charging function	Minimum requirement Evaluation criterion	The charging power of the docking station should at least match the notebook's power requirement. Universal charging functionality only with USB-C docks
		▪ Mechanical theft protection for the docking station ▪ Mechanical theft protection for docked notebook	Minimum requirement Evaluation criterion	Docking station has a device for attaching a cable lock Option to lock the notebook to the docking station. Only with proprietary docking connection.
		WOL/PXE 2.x	Minimum requirement	WOL should also be possible from the energy-saving states S4 and S5. Always implemented as a manufacturer solution.
		Use of a device-related MAC address (MAC address passthrough)	Evaluation criterion €	Always implemented as a manufacturer solution.

No.	Criterion	Requirements	Suitable as	Remarks
3	**Connections**	2 digital connections for screens (can be used in parallel)	Minimum requirement	The exact type should be specified (e.g. HDMI, Mini HDMI, USB-C, DisplayPort, Mini DisplayPort); adapters should be permitted to ensure broad competition.
		RJ45	Minimum requirement	
		4 x USB, of which at least 2x USB 3.x	Minimum requirement	
		Audio-in & audio-out	Minimum requirement	The provision of a combined interface, including a splitter adapter if necessary, also meets the requirement
4	**Mains adapter**	Power supply matching the docking station	Minimum requirement	The docking station must be supplied with a mains adapter in a suitable rating.

Table 8: Criteria and requirements in regard to docking functionality

4.7 Operating system

Criterion	Requirements	Suitable as	Remarks
Operating system	OEM license	Minimum requirement	The most commonly used operating system is currently Windows 10. At present, Windows 11 comes with a downgrade option to Windows 10. If operating systems older than Windows 10 are available, the procurement should be used as an opportunity to switch to a new operating system. A commitment to Windows LTSB/LTSC is expressly not recommended, as these versions are only intended for industrial PCs and similar static IT systems. Depending on the requirements, it may also make sense to use Linux or Mac OS X as the operating system. Mac OS X is only available on Apple hardware.

Table 9: Criterion and requirement in regard to the operating system

4.8 Power supply

No.	Criterion	Requirements	Suitable as	Remarks
1	**Weight of the mains adapter and cable**	▪ High mobility: max. 430 g ▪ Low mobility: No specific recommendation, may be heavier than 430 g	Minimum requirement	If the total length (socket to notebook) of the cable and mains adapter will exceed 1.80 m, the maximum total weight of the mains adapter and cable must be increased. The weight depends on the performance of the mains adapter.
2	**Total length of cable and mains adapter (socket to notebook)**	1.80 m	Minimum requirement	

No.	Criterion	Requirements	Suitable as	Remarks
3	**Performance**	During office operation, a battery with a charge level of 10 percent must be charged to a charge level of at least 90 percent of its capacity within 3 hours.	Minimum requirement	The charging times of the batteries depend on the rating of the mains adapter and the battery capacity.
4	**Battery interchangeability**	▪ Can be replaced by a trained specialist (no glued batteries) ▪ Can be replaced with tools, if necessary by using special tools (by the user's IT department)	Minimum requirement Evaluation criterion	This will generally involve opening the notebook's housing.
		Can be replaced without tools (by the user's IT department)	Evaluation criterion	The housing does not need to be opened. Furthermore, only limited availability on the market. The solution is larger and heavier in form and design, which does not comply the general requirements for small and light devices.

Table 10: Criteria and requirements in regard to the power supply

Air freight

International rules and regulations for the transportation of batteries are governed by the United Nations (UN).[11]

Since January 1, 2020, the information on a successfully completed UN 38.3 test must be documented in much more detail and provided in the form of the UN 38.3 test summary. According to the German Federal Aviation Office, shippers are obliged to provide UN 38.3 test summaries on lithium battery tests on request[12].

11 You will find more information here:
↗ http://www.unece.org/trans/danger/publi/unrec/rev21/21files_e.html
↗ http://www.unece.org/fileadmin/DAM/trans/danger/publi/manual/Rev7/Manual_Rev7_E.pdf

12 Source: ↗ https://www.lba.de/SharedDocs/Downloads/DE/B/B32_Gefahrgut/Fachinformation_neu/B32_Transport_Zellen.pdf;jsessionid=048EE30ED3717F88758F4206CF432F9F.live11294?__blob=publicationFile&v=2

5 Environmental and health protection

5.1 General legal requirements

All legal requirements must be complied with, in particular Regulation 2013/617 on ecodesign requirements for computers and computer servers.

The Ecodesign Regulation for computers and computer servers establishes minimum legal requirements for placing these types of products on the EU market. In addition to desktop PCs, thin clients and smaller servers, these also include notebooks as well as mobile workstations, tablet computers, slates and mobile thin clients. The criteria of the Ecodesign Regulation for computers and computer servers are found here: ↗ https://eur-lex.europa.eu/legal-content/DE/TXT/?uri=CELEX:02013R0617-20170109

> The European Commission is currently revising the regulation. In addition to the adjustment of energy consumption values, the introduction of energy efficiency labels based on energy consumption in active mode is also under discussion.

Legal requirements apply equally to all notebooks and do not need to be included in the performance specifications.

5.2 Accessibility

Public administrations in Germany are legally obliged to procure accessible hardware and software. The general requirements for accessibility are laid down in Section 4 of the Disability Equality Act (BGG, see: https: ↗ //www.gesetze-im-internet.de/bgg/BJNR146800002.html) (for the legal basis and further information on accessibility, cf. Appendix B in this Guideline). Further specifications are contained, for example, in Part 1 of the Barrier-free Information Technology Ordinance BITV 2.0 (↗ https://www.gesetze-im-internet.de/bitv_2_0/BJNR184300011.html) to the BGG. Invitations to tender should refer to these or equivalent requirements (cf. Appendix B.2). The provider submits a self-declaration stating which accessibility requirements are met by the product offered and which cannot be met. DIN EN 301 549:2020-02 Accessibility requirements for ICT products and services must be used for this purpose. This is directly referenced in Part 1 of the Barrier-free Information Technology Ordinance BITV 2.0 (↗ https://www.gesetze-im-internet.de/bitv_2_0/BJNR184300011.html) to the German Disability Equality Act (BGG). In accordance with Section 31 (2) No. 1 VgV, this

permits a reference to DIN EN 301 549 in the performance specifications in order to appropriately accommodate the needs of users with disabilities in the award procedure. Templates for the self-declaration are provided in chapter 4 (»clause 4«) of the technical report CEN/CLC/ETSI TR 101 552 (2014-03, ↗ https://www.etsi.org/deliver/etsi_tr/101500_101599/101552/01.00.00_60/tr_101552v010000p.pdf).

DIN EN 301549 (in particular chapters 5, 8 and 11) contains an overview of accessibility requirements that must also be met by notebooks (cf. Appendix B.2 Relevant standards and regulations). ISO/IEC 20071-5 contains a comprehensive overview of accessibility features that are also applicable to notebooks (cf. Appendix B.3 Standards on accessibility features).

It must be ensured in the procurement of notebooks that a sufficient number of suitable interfaces are available for connecting assistive technology such as Braille displays or special keyboards and that drivers for the specific operating system are available. Notebook-specific drivers, e.g. for built-in card readers that are operated via the user interface, must also be programmed to be accessible. The physical requirements such as button size, display properties or single-hand operation must be considered in detail. Furthermore, the additional resource requirements for screen readers, screen magnifiers and speech recognition in terms of computing power, memory and, in particular, the video controller must be taken into account during planning. It is also important to note that aids connected to the notebook – including a Braille display – are powered via the notebook, which reduces the battery life.

Notebooks placed on the market after June 28, 2025 fall under Article 2A of the European Accessibility Act, which requires the accessibility of, among other things, »(a) hardware systems and operating systems intended for such hardware systems for consumer general-purpose computers« (cf. Appendix B.5 Outlook).

5.3 Packaging

The return of packaging is regulated by the German Packaging Act (VerpackG[13]). If the packaging accumulates at the private consumer, the distributor or the dual system consumers commissioned by the distributor is obliged to take it back. Administrations, barracks or hospitals, among others, are treated as private consumers (see Section 3 VerpackG para. 11). A detailed overview can be found in the Central Packaging Register (↗ https://www.verpackungsregister.org).14
Taking back packaging should always be free of charge.
As there are currently no costs other than logistics costs, the requirement of an exclusion criterion should also be examined.

13 ↗ https://www.gesetze-im-internet.de/verpackg
14 ↗ https://www.verpackungsregister.org/fileadmin/files/Katalog/Uebersicht_Anfallstellen_Stand_September_2019.pdf

5.4 Quality mark for verification

Public procuring authorities may request the submission of quality marks as proof of conformity of the bid with the characteristics required in the performance specifications.

If the procuring authority requires the submission of a specific quality mark for verification purposes, this must be usable under public procurement law, that is, in particular suitable for verifying the characteristics required in the performance specifications (Section 34 (2) VgV). Moreover, alternative quality marks with equivalent performance requirements must also be accepted.

It is important to distinguish between the quality mark as possible proof and the actual requirements for the procurement item.

Eco-label:
Public procuring authorities are increasingly imposing requirements that go beyond the statutory minimum standard and which also (fully or partially) meet the requirements of environmental quality labels (particularly in the areas of energy consumption, service life and noise emissions). As proof that a service meets certain environmental requirements, the public procuring authority may require the presentation of environmental quality labels. The public procuring authority is entitled assume that testing institutes of the eco-label providers will test and evaluate compliance with the requirements (both those that are enshrined as mandatory in law and stricter ones). Depending on the choice of an eco-label as proof and/or for the formulation of the environmental requirement, devices or suppliers might be excluded from competition, which would result in a corresponding narrowing of the market. Conditions for the use of quality marks are stipulated by public procurement law.

However, many environmental quality labels and their requirements are barely mutually comparable. Not least for these reasons, this Guideline recommends that tenders specifically define the criteria and environmental requirements for the devices. Not only environmental quality labels, but also test protocols from suitable, independent testing institutes could be approved as proof of compliance with these criteria. It is important to bear in mind when planning the timing that performing the test and preparing the test reports may take some time, like the issue of the eco-labels themselves (if they are only applied for during the bidding period). For this reason, the approval of self-declarations as proof of compliance with the relevant requirements should also be considered, potentially in conjunction with supplementary verification by independent testing institutes or eco-labels after the contract has been awarded.

By law, manufacturers of electronic products must fulfil mandatory requirements for environmental compatibility (e.g. environmentally friendly disposal of old devices, ban on certain constituents for products, electromagnetic compatibility). Manufacturers

who do not meet these basic legal requirements are not allowed to place their products on the EU market.

The recommended and widely accepted ecolabels, their criteria and areas of application that are relevant for certain requirements are listed hereinafter. The procurer must decide on a case-by-case basis which of these quality marks are permissible for verification in the respective area of application.

ENERGY STAR: ENERGY STAR is a voluntary program by the US Environmental Protection Agency (EPA. ENERGY STAR products are certified by independent certification bodies and listed in the ENERGY STAR database (↗ https://www.energystar.gov/productfinder/). The EPA also requires that a product sample be tested. The eco-label itself should no longer be required in EU tenders after expiry of the EU Energy Star program in 2018. Alternatively, the Energy Star criteria can be used in the tender documents.

EPEAT: EPEAT is a leading global ecolabel for the IT industry (administered by the Global Electronics Council, GEC). The EPEAT program provides independent verification of manufacturers' claims and the EPEAT online registry lists sustainable products from a wide range of manufacturers. The criteria for notebooks (IEEE 1680.1a-2020 in conjunction with IEEE 1680.1-2018) can be found here: ↗ https://ieeexplore.ieee.org/browse/standards/get-program/page/series?id=86. It is important to note in regard to the EPEAT standard that the registration is valid for Germany. Currently approved notebooks can be found via this search: ↗ https://epeat.net/search-computers-and-displays. Around 600 notebooks are currently registered for the German market (as of August 15, 2022).

TCO Certified for notebooks: TCO Certified is a leading global sustainability certification for various product categories. Comprehensive criteria promote social and ecological sustainability throughout the entire IT product life cycle. Compliance with the regulations is checked independently, both before and after certification. The current version (as of March 2022) is Generation 9. Care should be taken to always request the latest valid version.15 The current criteria for notebooks can be found here: ↗ https://tcocertified.com/files/certification/tco-certified-generation-9-for-notebooks-edition-2.pdf

15 As a rule, the TCO criteria are revised every three years and certificates are valid for two years. For a transitional period, certified devices for different versions may therefore be available on the market, which should be taken into account in the tendering process. Procuring authorities can use the TCO Certified Product Finder to obtain an overview of the devices that have already been certified (↗ https://tcocertified.com/de/product-finder/).

Blue Angel: The Blue Angel for computers and keyboards (current version as of March 2022: DE-ZU 78) is a voluntary environmental label that is intended to distinguish products that are particularly environmentally friendly. For all products that meet the criteria of the label, permission to use the environmental label for the respective product can be granted by RAL gGmbH upon application, which is then based on a label usage agreement. The award criteria can be found here: ↗ https://www.blauer-engel.de/de/produktwelt/computer-und-tastaturen. There are currently no mark holders for notebooks (as of March 14, 2022). A general overview and assessment of these and other ecolabels can be found in the BMU brochure Environmental Information for Products and Services (Berlin 2019).16

5.5 Determination of energy consumption to accommodate energy efficiency in public contracts

Requirements must be observed that take into account the highest level of energy efficiency (e.g. in accordance with Section 67 VgV (highest level of energy efficiency)) when awarding public contracts for energy-related supplies or services.

Energy efficiency describes the ratio of a certain output to its energy input. With constant output, energy efficiency increases with decreasing energy consumption.

To determine the energy consumption (energy use), this Guideline recommends using the calculation rule for determining the Etec value (Typical Energy Consumption in [kWh] per year) of the ENERGY STAR® Program Requirements for Computers, as amended. The ENERGY STAR® Program Requirements for Computers provide standardized rules for determining the typical energy consumption per year in [kWh]. One of the predefined scenarios with different weighting parameters (mode weightings) can be selected.

If the specified scenarios of the ENERGY STAR® Program Requirements for Computers are not appropriate, the awarding authority may consider an individual calculation rule for energy consumption. As far as possible, this individual design should be limited to an individual change of the weighting parameters (mode weightings) according to ENERGY STAR® Program Requirements for Computers in order to remain as close as possible to the recognized standard specifications.

ETEC values from different Energy Star versions are not mutually comparable due to varying calculation methods/weightings. If specific ETEC values are required in a tender, the ENERGY STAR® version that defines the calculation method must be specified.

16 ↗ https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/umweltinformationen_produkte_dienstleistungen.pdf

The corresponding energy costs can be calculated using an appropriate energy price per kWh to be set by the awarding authority. Energy costs can be taken into account during the award procedure, for example, in the form of a valuation price for energy costs.

5.6 Social sustainability

In addition to economic and ecological criteria, social aspects must also be taken into account in the award procedure (Sections 97 (3) GWB, 31 (3) VgV for awards in the upper threshold range, Sections 2 (3), 22 (2) UVgO for awards in the lower threshold range). These social aspects include, in particular, employee rights, the prohibition of child labour, employee discrimination and compliance with framework working hours by the bidder and its suppliers. The awarding authority may require each bidder in the procedure to submit a declaration on social sustainability for IT to ensure that these aspects are taken into account in award procedures for IT products and IT services. The declaration, an associated text module for drafting contracts and explanations on the scope of application are available on the ↗ website of the Procurement Office of the Federal Ministry of the Interior.

Additional information on the Declaration of Commitment on Social Sustainability for IT is found here: ↗ http://www.nachhaltige-beschaffung.info/SharedDocs/DokumenteNB/Verpflichtungserklärung_ILO_BeschA_Bitkom_2019.html?nn=3631266

An overview of other aspects of sustainable procurement of IT products is summarized on this page of the Federal Procurement Office:
↗ http://www.nachhaltige-beschaffung.info/SharedDocs/DokumenteNB/Produktblätter/Informationstechnik.pdf?__blob=publicationFile&v=10

6 Security

Notebooks can be the target of cyber attacks, data theft and data misuse. Attacks of this kind jeopardize the confidentiality, availability and integrity of the data processed and stored by the devices, as well as the functionality of the devices themselves. Modern notebooks can be equipped with integrated security functions ex works, which can support compliance with security requirements. Ultimately, however, data protection and data security can only be achieved through a combination of organizational measures, due diligence on the part of the device user and security functions inherent to the device.

No.	Criterion	Requirements	Suitable as	Remarks
1	**Mechanical theft protection**	▪ Device for mounting a mechanical anti-theft device ▪ anchored in the inner notebook frame	Minimum requirement	Suitable locks etc. must be purchased separately as accessories. May influence the design/thickness/ dimensions of the device. Refer to the docking functionality for additional locking options.
2	**TPM**	▪ TPM 1.2/2.0 ▪ If TPM available: can be deactivated in the firmware (see also TCG PC Client Platform Firmware Profile 6.1). The operating system must not be able to reverse this deactivation. *-or-* ▪ No TPM or irrevocably deactivated	Minimum requirement	TPM (Trusted platform module) is a function that stores keys, passwords & digital certificates. Delivery of a TPM 2.0 is recommended for use with Windows 10. TPM 2.0 is mandatory for the use of Windows 11. For other use (virtualization, Linux): Delivery without TPM or with deactivated TPM recommended. An upgrade and downgrade between TPM 1.2 and 2.0 may be required, depending on the intended use.
		Pre-boot hard disk password, option in firmware	Evaluation criterion	If configured accordingly, the hard disk can only be started after a password has been entered.
		Password option for access to firmware (e.g. BIOS/UEFI)	Minimum requirement	Access to the firmware based on graded rights with firmware passwords. An access password should be set during initial commissioning, depending on the user's internal security policy.
		Individual firmware settings	Evaluation criterion	The delivery status may contain BIOS/ UEFI/coreboot settings specified in advance by the procuring authority.
		▪ Secure booting (»Secure Boot«) to check the integrity of the hardware components ▪ Can be switched off in firmware	Minimum requirement	

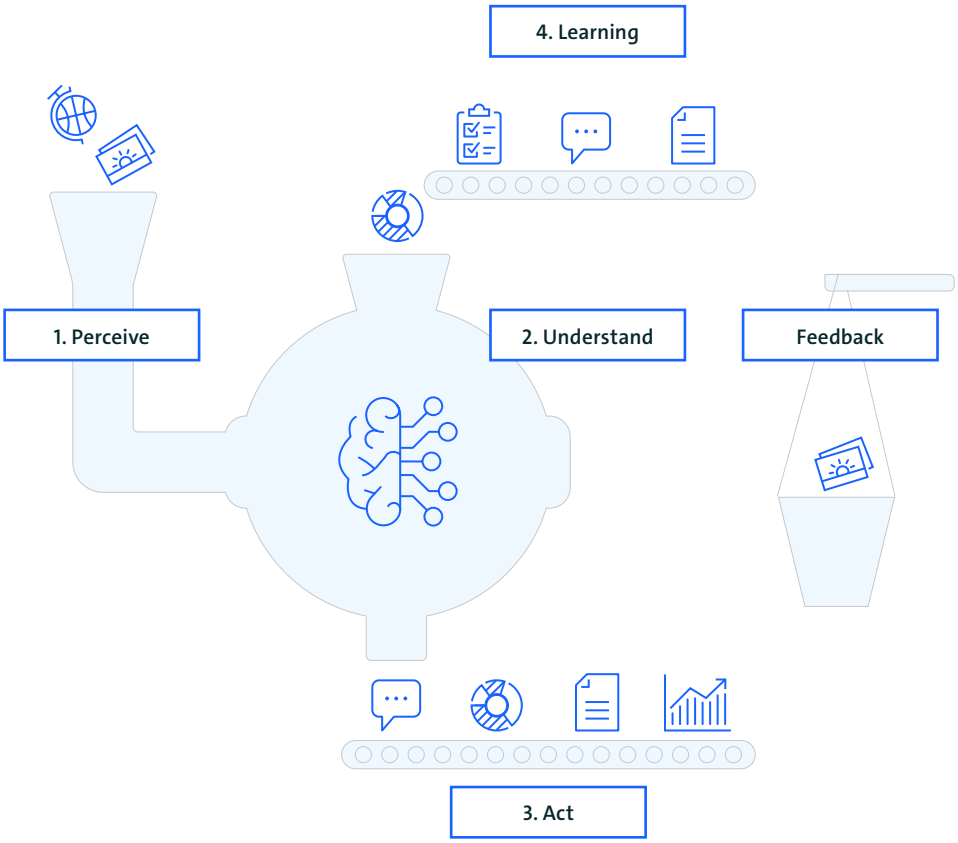
No.	Criterion	Requirements	Suitable as	Remarks
3	**Out-of-band management**	If available, delivered deactivated in firmware; can only be activated with firmware password	Minimum requirement	Remote maintenance functions that can change the firmware and/or data independently of the operating system must be delivered in a deactivated status, if available. Activation of the functions must only be possible with firmware password protection. When deactivated, the functions may neither establish nor accept network connections. 
4	**BIOS/UEFI/coreboot manipulation security**	Detection of and protection against tampering, reliable notification of the owner or user.	Minimum requirement	The systems must have mechanisms that prevent manipulation of the firmware itself (e.g. through write protection) or detect manipulation (e.g. through signature verification) and reliably notify the owner or user in such cases.
5	**Firmware, hardware**	Patch management available and information on patch management for vulnerabilities in firmware and hardware	Minimum requirement	Firmware here means firmware that runs on the main processor (e.g. BIOS, UEFI, Coreboot) or can influence it (e.g. Intel ME, AMD PSP).
		Once a critical vulnerability (CVSS 2.0 base score 7.0-10.0) in the firmware has been made public, it must be rectified without undue delay and communicated accordingly.	Minimum requirement	The bidder should provide detailed documentation on how vulnerabilities in hardware and firmware are handled, including dependencies on third parties (e.g. suppliers). This documentation includes estimated deadlines for the rectification of firmware vulnerabilities.
		The procuring authority must be notified without undue delay if a critical hardware vulnerability becomes publicly known. A workaround or patch will be provided within 6 months if possible, depending on the nature of the vulnerability.	Minimum requirement	It may not be possible to patch hardware vulnerabilities (e.g. Spectre variants), so the obligation to provide information is paramount in this case. Workarounds may restrict use.
		The firmware passes the BITS/CHIPSEC test suite without an error message	Minimum requirement	The bidder shall execute the protocols of the BITS/CHIPSEC test suite and update these protocols in the event of firmware updates and hardware changes.
		The Windows Platform Binary Table (WPBT) is not used.	Evaluation criterion	Can be used for the infiltration of malware
6	**Encryption**	Drive encryption	Minimum requirement	Encryption is achieved either through the drive's integrated hardware and firmware (e.g. Opal, eDrive) or through software.
7	**Interface protection**	Interfaces can be deactivated in BIOS/UEFI/coreboot	Minimum requirement	E.g. Ethernet, USB, Wi-Fi, WWAN, Bluetooth, camera, microphone, fingerprint sensor, etc.

No.	Criterion	Requirements	Suitable as	Remarks
8	**User authentication**	Options for multifactor authentication	Minimum requirement	E.g. smartcard, fingerprint, Other biometric features, etc.
9	**Webcam cover**	Integrated physical webcam cover	Evaluation criterion	
10	**Privacy screen**	Privacy filter	Minimum requirement	Solution depends on the system manufacturer. 

Table 11: Criteria and requirements in regard to security

7 Use of AI tools

With its vast potential to solve complex problems and deliver innovative solutions, artificial intelligence (AI) is revolutionizing the world of technology. AI algorithms enable computers to recognize patterns in large volumes of data and draw conclusions on this basis, without being explicitly programmed.



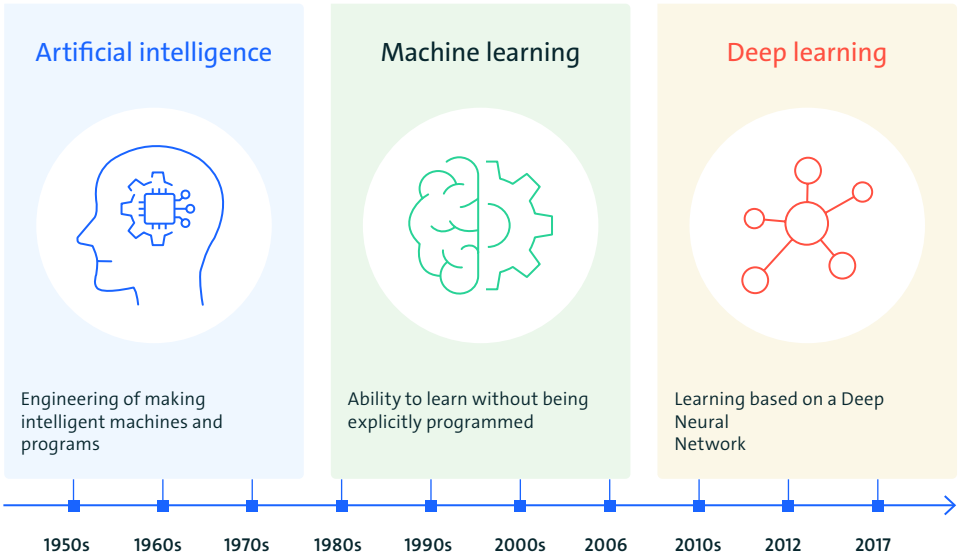
Commonly used algorithms are based on neural networks, support vector machines, decision trees, random forests, K-means clustering, recurrent neural networks (RNNs) and convolutional neural networks (CNNs). These algorithms are developed using a combination of training with annotated data and optimization of the model parameters.[17] The training process typically involves adjusting the model parameters to the training data in order to maximize prediction accuracy. Selection of the appropriate algorithm depends on the specific task and the available data.

17 Annotated data means data that has been provided with additional information or »annotations« to make it easier to understand for certain purposes or analyses. This additional information can be added by humans or automated processes and is used to identify or mark certain characteristics or properties of the data

Alan Turing is considered a pioneer of artificial intelligence. As early as 1936, he published a calculation model that allowed numerical calculations on a machine. The so-called »Turing machine« provided the theoretical framework for computers. in 1950, he developed a test – named after him – to determine whether a machine could achieve the thinking ability of a human and whether the result could be distinguished.

The Deep Blue chess computer is another pioneer of artificial intelligence, which first defeated the reigning world chess champion Gary Kasparov in 1996. Deep Blue is viewed as the first machine to pass the Turing Test.

The three most influential deep learning architects are Yann LeCun from Facebook, Geoffrey Hinton from Google and Yoshua Bengio from the University of Montreal. Another milestone was reached in November 2022 when OpenAI, a US company, published ChatGPT (Generative Pre-trained Transformer) and triggered additional hype.



The potential of AI extends across various industries, including healthcare, finance, manufacturing, automotive and administration. In medicine,
AI helps in the diagnosis of diseases and the development of personalized treatment plans.
In finance, AI enables the analysis of market trends and the prediction of investment strategies.
In manufacturing, AI optimizes production processes and improves the quality of products. In the automotive industry, AI is driving the development of autonomous vehicles. In administration, AI supports document management (e.g.: evaluation of e-files).

Requirements

The implementation of AI hinges on the implementation of certain hardware requirements. High-performance processors such as graphics processing units (GPUs) and specialized AI chips (neural processing units (NPUs)) accelerate calculations and improve the performance of AI systems. In addition, large data storage capacities are required to store data for the training and execution of AI models. This is why most AI models (ChatGPT, DALL E, Adobe) are currently made available via various cloud services.

There is a fundamental difference between inference and training AI models. During training, AI models are trained to recognize patterns and make predictions using training data. This process requires intensive computing resources and can take some time. After training, the trained models are used for inference, where they are applied to new data to make predictions or decisions. Inference requires less computing power than training and takes place in real time in order to respond quickly to requests.

Typical AI scenarios are Large Language Models (LLM) such as ChatGPT, Stable Diffusion (text to image/video) and image detection. LLMs currently represent the greatest potential in the AI industry. One of the best-known models is ChatGPT developed by OpenAI.

Current development and status quo

Artificial intelligence for office use is still in the development phase, and it will be some time, for example, before a Microsoft Windows operating system with special AI functions is available. While AI is already widely used in various sectors such as healthcare, finance and manufacturing, applications for
office requirements are still in their infancy. The integration of AI into operating systems such as Windows 11 could enable future functions that increase productivity, including intelligent file management, automatic document analysis or personalized user experiences. But further research, development and testing phases are required to ensure the reliability and efficiency of AI technologies before such applications reach market maturity. The same currently applies to comparable benchmark applications. We will monitor the technology and trends as part of the technical committee and update them in due course.

8 Award criteria

The contract must be awarded to the most commercially beneficial bid in accordance with Section 127 of the Act against Restraints of Competition (GWB). The most commercially beneficial bid is determined on the basis of the best price-performance ratio. In addition to price or costs, qualitative, environmental or social award criteria can also be taken into account. Energy efficiency must be given appropriate consideration as an award criterion in the case of delivery services that are relevant to energy consumption, Section 67 (5) VgV.

The performance requirements can be formulated within the framework of award criteria with minimum technical requirements or as part of evaluation criteria. It is at the discretion of the procuring authority to decide on which category individual performance characteristics should be assigned to. In general, criteria specify minimum requirements that are essential for the intended use of a device. Where this Guideline recommends minimum requirements for the devices, this is indicated in the criteria tables with »Minimum requirement«. If the criteria or requirements are marked with »Evaluation criterion«, the Guideline recommends using these requirements only in the context of evaluation criteria.

Using evaluation criteria to formulate the performance requirements can give competitors a particular leeway within which a nuanced consideration of the services offered is enabled within the scope of the evaluation. This allows the individual characteristics of competitors' services to be taken into account, which is beneficial for ensuring broad competition. When formulating the performance requirements, attention should be paid to the presentation of a detailed, comprehensible and objectively assessable expectation or assessment horizon.

The increased or even exclusive use of minimum technical requirements in the performance specifications comes with the risk of unintentionally restricting competition.

The Guideline recommends the use of evaluation criteria in order to promote the broadest possible competition.

9 Contractual provisions

9.1 EVB-IT

The provision of the tendered services or the delivery of the tendered products after successful completion of the award procedure is based on relevant contracts in each case. To support the awarding authorities, the Federal Ministry of the Interior and Bitkom have prepared various contracts that can be used for this purpose. The contracts are found on the website of the Federal Government Commissioner for Information Technology (↗ https://www.cio.bund.de/Web/DE/IT-Beschaffung/EVB-IT-und-BVB/Aktuelle_EVB-IT).

Appendix A – Benchmarks

1. Benchmarks – Environment variables

The awarding authority must stipulate certain minimum requirements for setting up the notebook systems in the tender documents. This applies both to cases in which the awarding authority itself carries out or commissions benchmarks and to cases in which it requires bidders to provide evidence of benchmark tests. It is reasonable to expect fewer questions of the specifications regarding settings and version numbers for operating systems and
benchmarking procedures are specified in more detail in the tender.

For example, the environmental parameters influence the benchmark values, which is why we recommend that the manufacturer or provider carries out the benchmark measurement under the following conditions:

- Air temperature 20 – 22 degrees Celsius
- Relative humidity max. 50%
- Air speed max. 15m/s

Measurements via independent measuring laboratories, manufacturer laboratories and accredited measuring laboratory

A measurement laboratory, regardless of whether it is a manufacturer or not, can create sufficient test reports in accordance with EU legislation. Accreditation is not required.
Examples include the CE declaration or the ECO declaration. ECO labels demand higher quality requirements.

ECO labels such as EnergieStar and TCO require test reports from an independent test laboratory that is accredited for this measurement in accordance with DIN EN ISO/IEC 17025.

An accredited measurement laboratory can also be a manufacturer's measurement laboratory, provided it is accredited in accordance with DIN EN ISO/IEC 17025.

Screen brightness

The setting must be maintained for the duration of the test except when dimming the screen, switching off the screen or using connected standby (see below).
In cases where the brightness of 200 nits in battery mode – measured at the centre of the screen with a white background – is not reached, the brightness of the screen

> It must be documented if a battery-powered system cannot reach 200 cd/m².

should be set to the maximum brightness value for the test, unless dimming of the screen is used (see below).

2. BIOS/firmware

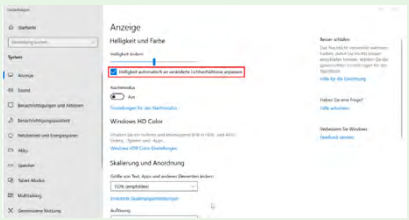
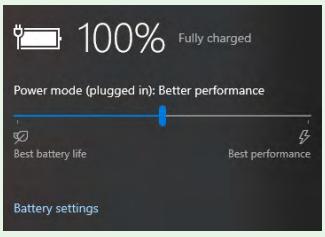
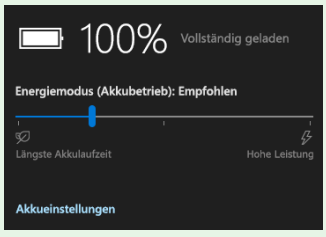
Parameters	Description	Classification
BIOS version	The latest BIOS version from the manufacturer must be used.	Required
BIOS delivery settings	Some BIOS settings may significantly impact the benchmark results and the default settings that were configured when the device was delivered must be used.	Required

3. Operating system/drivers

Parameters	Description	Classification
Installation procedure	It is strongly recommended to perform a new installation of the operating system and not to use an operating system image file with pre-installed drivers or other (manufacturer-specific) software. This is due to some operating system features, such as super/prefetch, which can make it difficult to compare the results of images. It is also expected that the operating system's respective default settings are used during installation. In addition, the operating system should be installed in offline mode (otherwise daily updates are installed automatically, making comparability more difficult). The current basic version of Windows 10 (e.g. 1909) can be created using the Media Creation Tool from Microsoft (»MediaCreationTool1909.exe«). The tool generates an ISO image or a bootable (UEFI) USB stick (at least 8GB): ↗ https://www.microsoft.com/de-de/software-download/windows10 In addition, the precise Windows version (basic version & build) should be specified in the tender. Further information can be found on the website: ↗ https://docs.microsoft.com/de-de/windows/release-information/ The corresponding build can be installed using the KB article (which is available on the website).	Required
Operating system	Under no circumstances should benchmark results from Windows 10 be compared with results from older Windows operating systems or Linux.	Required
Operating system – Maintenance	It is strongly recommended to include the performance of automatic maintenance (defragmentation of the storage media) of the operating system after installation as a required item in the tender documents. If the benchmark starts directly after installation, the result may be falsified by the maintenance running in the background.	Required 
Operating system – Changing settings	It is recommended to prohibit any changes to the default settings of the operating system (which are not necessarily required by the benchmark). An unbiased user of the benchmark should be able to reproduce the benchmark without specialist knowledge or explanations.	Required

Parameters	Description	Classification
Operating system – Automatic updates	Automatic operating system updates must be deactivated. As a rule, the test system must be benchmarked without a connection to the internet, only with the specified updates. Allowing automatic updates can lead to different software versions and hence make the comparability process more difficult.	Required
Driver versions of the system manufacturer	The latest driver package from the system manufacturer must be used. The current driver package is available on the system manufacturer's website.	Required

4. Others

Parameters	Description	Classification
Ambient light sensor	The ambient light sensors regulate the image background brightness according to the ambient brightness. It is recommended to switch off the ambient light sensor if possible. The screen brightness must be set to a value that is not less than 200 cd/m², measured in battery mode at the centre of the screen with a white background. It is recommended to perform the benchmarks with the minimum resolution defined in the tender. 	Optional
Battery calibration	To ensure an exact battery life, it is recommended to run two charging cycles (fully charge & discharge) before measuring the battery life for new devices.	Optional
Battery measurement – Windows Power Management	If there is no other specification, the energy option »Balanced (better performance)« should be selected.  	Optional

Appendix B: Information on accessibility

B.1 Definition of accessibility

»Accessible [...] information processing systems [...] are those that are locatable, accessible and usable

- in the usual way,
- without particular difficulty and
- basically without outside help

for people with disabilities.

The use of disability-related aids is permitted.«
(BGG Section 4) Aids include, for example, special keyboards, alternative pointing devices, screen readers or screen magnifiers.

B.2 Relevant standards and regulations

The accessibility criteria must be taken into account when preparing the performance specifications for the procurement of notebooks, except in factually justified exceptional cases:

- Procurement Law Modernization Act (VergRModG) (April 18, 2016)
  (Implementation of Directive 2014/24/EU Directive 2014/25/EU) Section 121 Performance specifications, paragraph 2
- Act on the Equality of Persons with Disabilities
  (Disability Equality Act – BGG), (July 10, 2018)
  Section 12 Barrier-free information technology, paragraph 2.

In this regard, particular attention must be paid to ensuring that the requirements are geared towards user needs and are also technology-neutral and open to innovation.

The European Commission instructed the European standardization organizations CEN, CENELEC and ETSI to create a standard in order to harmonize the accessibility requirements for the procurement of information and communication technology products and services by the public sector in Europe. The result of the contract is the European Standard EN 301 549:2018-08
(↗ https://www.etsi.org/deliver/etsi_en/301500_301599/301549/02.01.02_60/en_301549v020102p.pdf), which is listed in the Official Journal of the European Union

under Directive (EU) 2016/2102 on the accessibility of the websites and mobile applications of public sector bodies. This European standard was implemented with DIN EN 301 549:2020-02 Accessibility requirements for ICT products and services. Proof should be provided by the contractor in the form of a self-declaration. Certificates cannot be requested as proof, as a suitable certification option does not currently exist.

B.3 Standards on accessibility features

ISO/IEC 20071-5 »Information technology – User interface component accessibility – Part 5« provides a comprehensive overview of accessibility features that must also be fulfilled by notebooks: Accessible user interface for accessibility settings on information devices«. This standard is currently in draft form and is expected to be published in 2021. The annex to the standard can be used as a checklist when preparing an offer. The accessibility features are listed in Chapter 4.2 of the standard.

B.4 Management system standards for accessibility

DIN EN 17161: »Design for all – Accessibility of products, goods and services according to a »Design for all« approach – Extending the circle of users« is a management system standard that helps organizations to ensure accessibility in their processes. Their use is not mandatory, but helpful for self-declaration.

B.5 Outlook

An update of the standard is already available as EN 301 549 (2019-11, ↗ https://www.etsi.org/deliver/etsi_en/301500_301599/301549/03.01.01_60/en_301549v030101p.pdf). Its publication in the Official Journal of the EU and its translation as DIN EN 301 549 is expected in 2021.

The EU Directive 2019/882/EU on the accessibility requirements for products and services (European Accessibility Act, EAA) (↗ https://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:32019L0882&from=EN) requires in Article 2 »Scope« (1), »Products«, among other things, the accessibility of the following products that are placed on the market after June 28, 2025:
»(a) hardware systems and operating systems intended for such hardware systems for general purpose consumer computers;« The EAA stipulates accessibility as part of the self-declaration in CE marking.

B.6 International self-declaration

The following information may be helpful for the self-declaration of ICT providers operating internationally: The Information Technology Industry Council (ITI) provides a free reporting tool known as the Voluntary Product Accessibility Template (VPAT) to determine whether information and communication technology products and services meet accessibility requirements, including the US Rehabilitation Act Section 508 rules. The ITI has published revised editions of VPAT (2.4) based on the revised 508 rules of the US Access Board (VPAT 2.4 508). In addition, versions for WCAG 2.1 (VPAT 2.4 WCAG) and EN 301 549 (VPAT 2.4 EU) as well as another version based on all three (VPAT 2.4 INT) are also available.
↗ https://www.itic.org/policy/accessibility/vpat

Bitkom represents more than 2,000 member companies from the digital economy. They generate annual sales of €190 billion with IT and telecommunications services alone, including exports of €50 billion. Bitkom members employ more
than 2 million people in Germany. Its members include more than 1000 SMEs, over 500 start-ups and almost all global players. They deliver software, IT services, telecommunications or Internet services, manufacture devices and components, are active in the field of digital media or are part of the digital economy in other ways. 80 percent of the companies are headquartered in Germany, 8 percent come from Europe and the USA respectively, and 4 percent are from other regions. Bitkom promotes and drives the digital transformation of the German economy and is committed to broad social participation in digital developments. The aim is to make Germany a leading global digital location.

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