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Tractors and machinery for agriculture and forestry — Serial control and communications data network —

Part 13: File server

Tracteurs et matériels agricoles et forestiers — Réseaux de commande et de communication de données en série —

Partie 13: Serveur de fichiers

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 19, *Agricultural electronics*.

This third edition cancels and replaces the second edition (ISO 11783-13:2011), which has been technically revised.

The main changes are as follows:

— removal of support for short, 8.3 format, path and file names;

— addition of support for Unicode characters in path and file names;

— addition of clarifications to improve the implementation and testability of the file server protocol.

A list of all parts in the ISO 11783 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO 11783 specifies a communications system for agricultural equipment based on the ISO 11898-2 protocol. SAE J1939 documents[1)], on which parts of ISO 11783 are based, were developed jointly for use in truck and bus applications and for construction and agriculture applications. Joint documents were completed to allow electronic units that meet the truck and bus SAE J1939 specifications to be used by agricultural and forestry equipment with minimal changes. General information on ISO 11783 can be found in this document.

The purpose of ISO 11783 is to provide an open, interconnected system for on-board electronic systems. It is intended to enable electronic control units (ECUs) to communicate with each other, providing a standardized system.

1) Society of Automotive Engineers, Warrendale, PA, USA.

Tractors and machinery for agriculture and forestry — Serial control and communications data network —

Part 13: File server

1 Scope

The message set specified in this document is designed to support the needs of tractors and implements in using the services of a file server (FS).

An FS is a distinct control function (CF) on the mobile implement control system that enables all CFs to store or retrieve data from a file-based storage device.

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 11783-1, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 1: General standard for mobile data communication*

ISO 11783-3, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 3: Data link layer*

ISO 11783-5, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 5: Network management*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11783-1 and the following apply.

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

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

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

3.1
client
control function (CF) on the mobile implement bus that uses the services of the *file server* (3.5)

3.2
directory
file which stores administrative information about other *files* (3.3)

3.3
file
data object that stores data on a storage device

3.4
file attribute
bit-coded information that defines the type and features of a *file* (3.3)

3.5
file server
FS
control function (CF) on the mobile implement bus that provides storage for *files* (3.3) and uses a set of commands for the handling of, and access to, these files

3.6
filename
name conforming to requirements of a character set, which identifies a file or *directory* (3.2)

Note 1 to entry: See Annex A for the character set.

3.7
Handle
data object used for accessing *files* (3.3) and *directories* (3.2)

3.8
hidden attribute
file attribute (3.4) indicating that the file should not appear in a directory listing

Note 1 to entry: A *client* (3.1) sets this attribute by using the file server (FS) commands.

3.9
path
specification of a *filename* (3.6) that may also include the directory name

3.10
read-only attribute

file attribute (3.4) used to prevent writing to, or deletion of, a file

Note 1 to entry: A *client* (3.1) sets this attribute by using the file server (FS) commands.

3.11
volume
directory (3.2) that refers to a specific logical or physical storage unit or space

Note 1 to entry: The primary volume is the volume used as current volume when the file server (FS) is started.

4 Requirements

4.1 General message format

The general message format uses the parameter group number as the label for a group of parameters in accordance with Annex C. Each of the parameters within the group can be expressed as characters, as scaled data defined by the ranges given in 4.2, or as one or more bits. Characters shall be transmitted with the left-most character first. Numerical parameters consisting of two or more data bytes shall be transmitted least significant byte (LSB) first. Individual parameters shall be in accordance with Annex B. When variable-length messages have eight or less data bytes, these messages shall be transmitted in a single controller area network (CAN) frame. When variable length messages have nine or more data bytes, the transport protocol (TP) or the extended transport protocol (ETP), in accordance with ISO 11783-3, is required. When a message has less than eight data bytes, the unused bytes shall be filled with FF_{16} values.

4.2 File data format

4.2.1 Data

Data consists of a block of bytes (unsigned eight-bit values). All values in the range of 0_{10} … 255_{10} are allowed. There is no special handling of individual characters (control characters, end-of-line markers, end-of-file markers or similar characters).

4.2.2 Bit groups

Groups of one to eight bits are packed into one byte as bit 7 … bit 0. Groups of nine to 16 bits are packed into two bytes in the order of LSB as bit 7 … bit 0, followed by most significant byte (MSB) as bit 15 … bit 8. Unused bits in a bit group default to a value of 0 (zero).

4.2.3 Integer

Integer values are formatted as follows:

Unsigned 8 bit	1 byte	0 … 2^8–1	0_{10} … 255_{10}
Unsigned 16 bit	2 bytes, LSB first	0 … 2^{16}–1	0_{10} … 65535_{10}
Unsigned 32 bit	4 bytes, LSB first	0 … 2^{32}–1	0_{10} … 4294967295_{10}
Signed 32 bit	4 bytes, LSB first, two's compliment	-2^{31} … 2^{31}–1	-2147483648_{10} … $+2147483647_{10}$

4.2.4 Character string

A string contains characters represented by one or more bytes (unsigned eight-bit values). The length of a string is specified by a string length data item. The characters in a string used as a filename or a path name shall be as specified in Annex A. The support for Unicode characters is added in file server version 4, see B.5 Version Number. Prior to version 4, a character is by a single byte.

4.3 Data transmission control

4.3.1 General

Each communication transaction between a client and the FS is initiated by a request from the client and terminated by a response from the FS. In order to provide fail-safe communications, it is important that the client assigns the received response to a corresponding request and repeat an erroneous request without triggering the complete execution again.

4.3.2 Strategy

The client can issue a request and receive no response because of transient communication problems. The failure can happen during the request message, i.e. the FS does not receive the request, or during the response message, i.e. the client does not receive the response. The client cannot distinguish between these two cases and shall repeat the request to obtain the requested data.

If there is no transaction strategy, the problem of the FS not receiving the request is resolved by the client sending a second request and the FS responding with the requested data. However, if the client does not receive the correct response data message and sends a second request, the FS then sends the next data from the file; this is because a data request automatically advances to the next data in the file.

A transaction strategy is therefore required to prevent such errors. Each client on the network maintains its own transaction number (TAN) counter, which should start at 0 after a power cycle.

Each client generates a TAN for each request, that it sends to the FS. Each TAN shall be different from the previous. This can be done by incrementing the last TAN used, for the next request. The client is responsible for checking that a received response contains the same TAN that was used in the request during the communication session, thus ensuring that there are no lost commands. The FS shall remember the last command processed and response message sent for each client. The FS compares each new request with the previous request from the same client. If the TAN is not the same, the request is implemented, and the response is sent. If the TAN is the same as the previously received request, the request is not implemented, and the previous response is sent. Thus, if the client sends a second request, in the case where the FS never received the first request, the FS receives the TAN for the first time, implements the request and sends the correct data response. If the FS receives a request with the same TAN that it has already received, it does not implement the request, but the previous response is retransmitted.

4.3.3 Timeout

The execution time of all FS commands (the time between request and response) is maintained within reasonable limits. The client shall monitor the time while waiting for a response.

The timeouts specified in ISO 11783-3 for the transport protocol and the extended transport protocol shall be met for the execution of commands.

If a timeout expires, the request is assumed to have failed and the client shall repeat the request using the same TAN.

If a request response takes longer than 200 ms after the completion of the request, the FS shall send the status message to indicate busy state to the client. This provides a request timeout of 600 ms if the FS status message does not show a busy status.

4.4 Date and time support

Several FS commands require a file date and time. UTC[2] is used for this time. The file server's implementation of real time support can be either by maintaining its own real time information or by requesting the time and date information using the Time/Date parameter group specified in ISO 11783-7.

If a client requests the date and time for the root of a volume, or the volume list itself, the file server response shall include the error “Access denied”.

The file server shall respond with the most recent time where the folder/file was accessed if the operating system provides this information. Otherwise, the file server shall respond with the information that is available.

Due to possible date and time changes (by the operator or other means) there is no guarantee, that the date and time associated with files and folders indicates the actual chronological order, in which the files/folders were accessed.

4.5 Multi-client support

The file server shall support multiple clients. If more than one client has a connection simultaneously, the file server shall function with each client as if it is the only one on the network. There shall be no interference between the commands processed for different clients.

The file server shall accept connections from all clients on the network. If the file server has limited resources, it may limit the number of open file handles. Prior to file server version 4 the requirement to support all connections was not clearly defined.

Upon connection of a client, the file server initiates the current directory for that client as the root directory of the primary volume of the file server file system. If there are no volumes, then the current

2) Coordinated universal time, or universal time, formerly known as Greenwich mean time (GMT).

directory is set to the list of volumes "\\". The client is required to use the appropriate Change Current Directory or Open File commands to access files that need to be unique for that client. In the case where multiple clients require access to common files, these clients are responsible for synchronizing their directory and file naming conventions to enable access to these common files. To prevent unintentional access to manufacturer proprietary files, a reserved directory name is specified. The naming convention of the manufacturer-specific directory is:

MCMC0000

where 0000 contains the four-digit manufacturer code (defined in accordance with ISO 11783-5 and listed in ISO 11783-1) in decimal representation, formatted with leading zeroes. A client shall not use this manufacturer-coded directory name using a manufacturer code other than the manufacturer code in its NAME field. When the client attempts to open a file in a manufacturer-specific directory where the manufacturer code in the NAME of that client is not that of the manufacturer-specific directory name, the FS shall prevent access and return an "access denied" error code.

The complete value range from 0000 to 9999 shall be handled as manufacturer code, even though the manufacturer code is defined as an 11-bit value in ISO 11783-5, which limits the possible value range to 0 to 2047.

When a file server supports multiple volumes, manufacturer-specific directories can be created on each volume. Creation of a manufacturer-specific directory is the responsibility of the client. The manufacturer-specific directory shall only be placed at the root of each volume. If a folder with the same naming convention (MCMC0000) is found in a subfolder, it shall be treated like any other folder, i.e. it is not manufacturer specific.

4.6 File Handles

An FS may support multiple file Handles. Many of the commands available for the FS create and/or use file Handles. However, there are some commands that only use folder or filenames. Internally, if the FS creates a file Handle to process these commands, the number of open files shall be incremented to reflect the internal status of the FS.

4.7 Volumes

Different types of media (Flash memory, removable media, ruggedized disk drives, etc.) can be assigned to different volumes.

An FS can support multiple volumes. It is also possible for an FS to list no volumes — for example, with uninitialized media or no device found.

The root of a removable media is the root of the volume provided by the file server to the clients. For non-removable volumes, like display memory, a folder on that volume can be the root of the volume provided to the clients, in order to protect critical areas of this memory.

The list of volumes, specified by "\\", is the highest layer (or base) of a directory structure.

Executing a change current directory command with "..\" based on the root of a volume, would set the current directory to the volume list. Executing the command based on the volume list itself, will keep the current directory in the volume list.

If the current directory is the volume list, the client can use relative paths starting with the volume name.

EXAMPLE Relative path Vol1\ results in absolute path \\Vol1 if \\ is current directory.

It is recommended to use only media with a file system that supports long file names. The behaviour with other file systems is not defined and can result in unexpected behaviour when changing such volumes between file server systems.

The names of the volumes are determined by the FS; however, the manufacturer of a FS may allow a proprietary service tool to name volumes using the Initialize Volume Request message (see C.5.2.2).

NOTE This document does not specify how the service tool selects the media or volumes to initialize if they are not named and listed in the list of volumes "\\".

4.8 Primary volume

The primary volume shall be a removable media. If no primary volume is available when a client connects to the file server, Get Current Directory Response shall report an empty path and error code 4. Any file operations with a relative path shall return error code 4. When a removable media becomes available, and the current directory is still an empty string, the primary volume is being set to this removable media and current directory points automatically to the root of the removable media.

Servers shall use removable volumes as primary volume to be compatible with legacy clients which expect a removable media as the primary volume.

Clients should always read the volume list and select a volume suitable for their task.

See Figure 1.

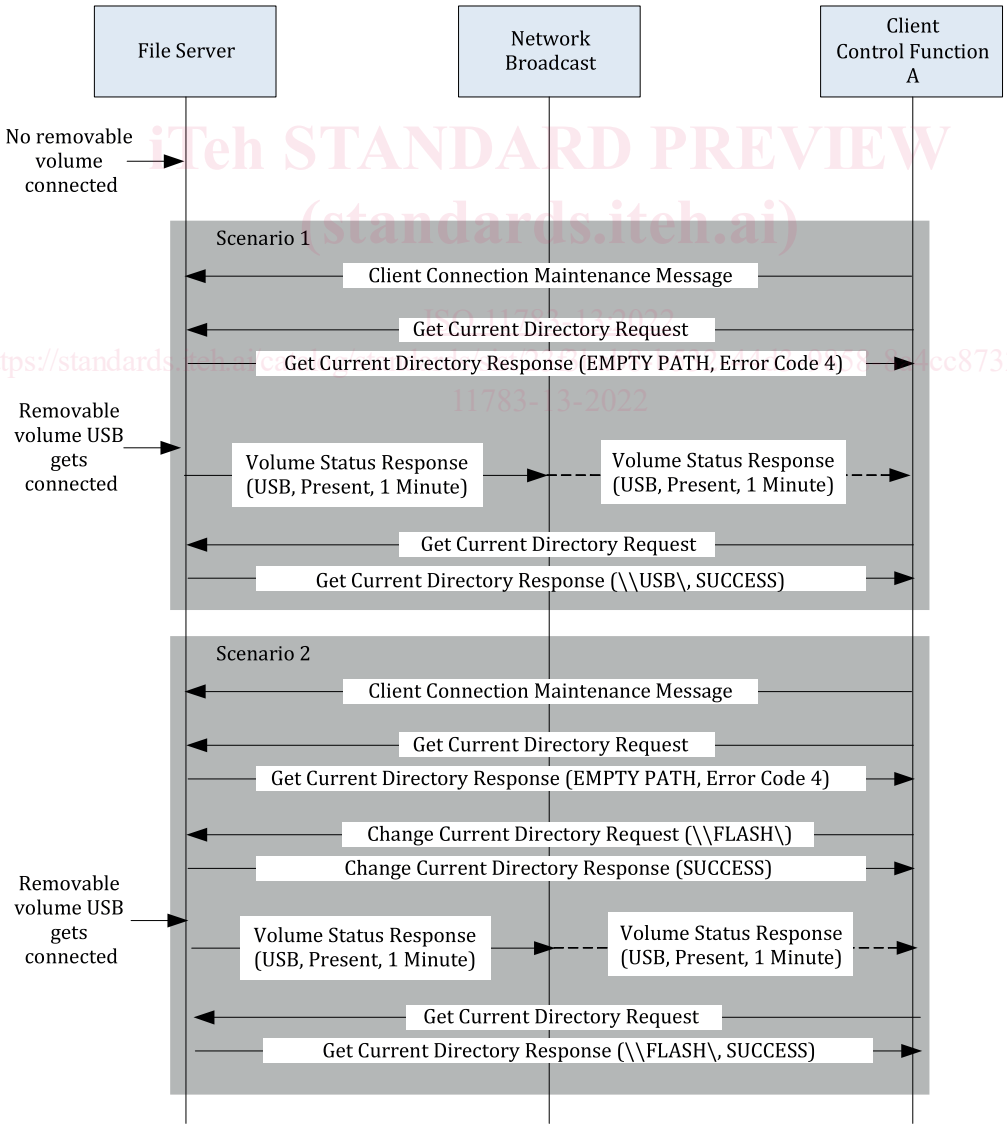

Figure 1 — Selecting initial directory

4.9 Commands

To help identify communication issues, the FS shall respond to all destination specific commands.

The FS shall respond with a NACK (ISO 11783-3), when receiving:

— unspecified commands;

— empty request message (0 data byte).

The file server shall respond with Error Code 47 Malformed Request, if it receives a message, which is shorter than expected.

4.10 Connection/Disconnection of a client

Clients shall establish connection to the file server by sending the Client Connection Maintenance message (CCM) (C.1.3). The connection shall be established before the client sends any messages containing a TAN to the file server. The CCM shall be repeated at 2-second intervals, to maintain the connection.

NOTE For version 3 and prior, the requirement for CCM was not clearly specified, therefore those clients might not be sending CCM as specified above.

The file server shall accept a client as connected when the file server receives the CCM or any Client to Server message containing a TAN. After 6 seconds without receiving CCM or any Client to Server message containing a TAN, the file server shall consider the client as disconnected.

When a client is disconnected, the file server shall close all files, which are open by the disconnected client, and all Handles associated with that client become invalid. The client's Current Directory shall be reset to the default.

See Figure 2.

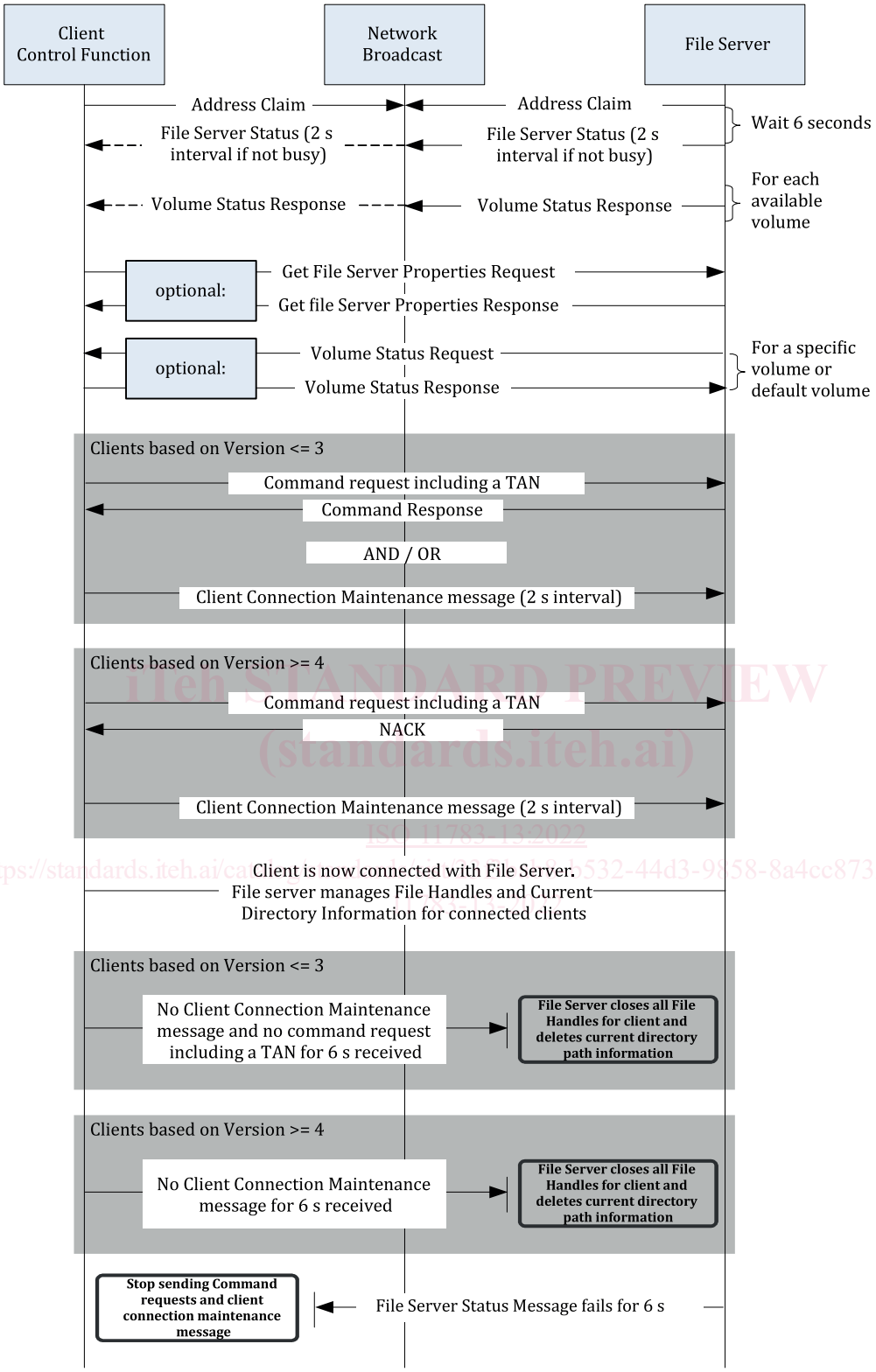

Figure 2 — Client connection and disconnection

Annex A
(normative)

Character set

A.1 Valid characters

The file server uses filenames and path names. Every character used for filenames and path names is validated by the FS using the filename and path definitions given in A.2. Only printable characters are visible when presenting the filename or path name to a user.

The support for short, 8.3 format, file names, has been deprecated in file server version 4. An FS server implemented according to version 4 is required to support filename and path names per the definitions provided in A.2.

A.2 Filename and path definitions

A.2.1 Nomenclature

Definitions:

[ ] any of the characters in the set, including none from the set (optional);

[A-B] defines an inclusive range from the first through the last;

( ) group;

< > character class;

\ escapes the following character, as in "\[", which indicates a single left bracket, not the containment of a set;

A | B sequence "A" or "B";

A + B sequence of A followed by B;

{m} exactly m of the preceding set;

{m,n} from m up to and including n of the preceding set;

\xXX character code in hexadecimal notation where XX are two hexadecimal digits (\x20, for example, indicates character code 32, which is the space character).

A.2.2 Name definitions

A.2.2.1 Names

Names are from one to 255 bytes in length, using the character set given below. The commonly used file systems given in Annex D were used to determine name restrictions that allow these names to be used with minimal feature loss.

Note that the length of names is specified in bytes. The number of bytes required for a name depends on the Unicode characters and Unicode encoding method used in that name.