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Foreword

This ETSI Technical Report (ETR) has been produced by the Terminal Equipment (TE) Technical Committee of the European Telecommunications Standards Institute (ETSI).

ETRs are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature, relating to the use or application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or I-ETS.

This ETR was drafted by ETSI Project Team 48 during October and November 1992. TC-TE agreed to the publication of this ETR in December 1992 but considered that it was not appropriate to select one of the alternative protocols proposed. Both protocols should be available to the users.

It was agreed that the ETR contains an excellent comparison of the two protocols available for simple file transfer over the Integrated Services Digital Network (ISDN). The following points were supported:

a) File Transfer Access and Management (FTAM) is internationally standardised and is available from most computer suppliers. It is specified in EPHOS 1 for public procurement in the EEC but, at present, it is not heavily used on the European ISDN;

b) ETS 300 075 [1] is preferred by users in several European countries for use on ISDN;

c) other possible protocols were not studied in detail because they appeared not to satisfy the basic requirements;

d) choice of the prefered protocol cannot be made as a result of the technical comparison - it should be a matter for the user;

e) the principle of Open Systems Interconnection (OSI) is that higher layer protocols are independent of the network technology and the most urgent need for the exploitation of ISDN is the implementation of the Connection Oriented Transport Service on ISDN. Therefore the publication and the implementation of the relevant International Standardised Profiles (ISPs) is a key step to the growth of the use of ISDN.

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1 Scope

With the availability of Integrated Services Digital Network (ISDN) throughout Europe and with the availability of inexpensive personal computers (PCs) there is a high demand for a Standardised Simple File Transfer (SSFT) protocol, as expressed by:

European ISDN User Form (EIUF);
ISDN MoU Implementation and Management Group (IMIMG);
ISDN Management and Co-ordination Committee (IMCC).

As there is a choice between several standardised protocols (not to speak of the many proprietary software packages) the task of this ETR is to "recommend, if possible, a single protocol stack for file transfer over the ISDN".

2 References

For the purposes of this ETR, the following references apply:

[1] ETS 300 075 (1990): "Terminal Equipment (TE); Videotex processable data".

[2] ETS 300 079 (1991): "Integrated Services Digital Network (ISDN); Syntax-based Videotex, End-to-end protocols circuit mode DTE-DTE".

[3] ETS 300 080 (1991): "Integrated Services Digital Network (ISDN); lower layer protocols for telematic terminals".

[4] ETS 300 081 (1992): "Integrated Services Digital Network (ISDN); Teletex end-to-end protocol over the ISDN".

[5] prETS 300 154: "Terminal Equipment (TE); Terminal characteristics for the telematic file transfer within the Teletex service [ITU-T Recommendation T.571 (modified)]".

[6] ETS 300 222: "Terminal Equipment (TE); Framework of Videotex terminal protocols".

[7] ETS 300 223: "Terminal Equipment (TE); Syntax-based Videotex, Common end-to-end protocols".

[8] prETS 300 325: "Integrated Services Digital Network (ISDN); Programming Communication Interface (PCI) for EuroISDN".

[9] prETS 300 243-1: "Terminal Equipment (TE); Programming Communication Interface (PCI) APPLI-COM for facsimile group 3, facsimile group 4, Teletex and telex services [CCITT Recommendation T.611 (modified)]".

prETS 300 243-2: "Terminal Equipment (TE); Programming Communication Interface (PCI) on ETS 300 243-1 (Application of CCITT Recommendation T.611 (1992))".

NOTE 1: This 2 part prETS is currently on indicative vote within TE. Assuming a positive outcome, they should be submitted for PE during November 1993.

[10] ISO/IEC 8571: "Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM)".

ISO/IEC 8571 - 1 (1988): "General Introduction".

ISO/IEC 8571 - 2 (1988): "Virtual Filestore Definition".

ISO/IEC 8571 - 3 (1988): "File Service Definition".

ISO/IEC 8571 - 4 (1988): "File Protocol Specification".

ISO/IEC 8571 - 5 (1990): "Protocol Implementation Conformance Statement (PICS) Proforma".

ISO/IEC 8571 - DAM1 Amendment 1: "Filestore Management".

ISO/IEC 8571 - DAM2 Amendment 2: "Overlapped Access".

ISO/IEC 8571 - DAM3 Amendment 3: "Service Enhancement".

[11] EN 41216 (ISP 10607): "Information Technology - International standardised profiles AFTnn - File Transfer, Access and Management (FTAM)".

EN 41216-1 (1991): "Specification of ACSE, Presentation and Session Protocols for the use by FTAM (ISO/IEC ISP 10607-1 1st edition 1990, modified)".

EN 41216-2 (1991): "Definition of Document Types, Constraint Sets and Syntaxes (ISO/IEC ISP 10607-2 1st edition 1990, and its amendmend 1, 1991, modified)".

EN 41216-3 - AFT11 (1991): "Simple File Transfer Service (Unstructured) **(**ISO/IEC ISP 10607-3 1st edition 1990, modified)".

EN 41216-4 - AFT12 (1992): "Positional File Transfer Service (Flat) (ISO/IEC ISP 10607-4 1st edition 1991, modified)".

EN 41216-5 - AFT22 (1992): "Positional File Access Service (Flat) ISO/IEC ISP 10607-5 1st edition 1991, modified)".

EN 41216-6 - AFT3 (1992): "File Management Service (ISO/IEC ISP 10607-6 1st edition 1991, modified)".

NOTE 2: The numbering of these ENs is still under discussion within CEN/CENELEC.

[12] ISO TR 8509 (1987): "Information processing systems - Open Systems Interconnection - Service conventions".

[13] ITU-T Recommendation T.61: "Character repertoire and coded character sets for the international teletex service".

[14] ITU-T Recommendation T.571 (1993): "Terminal characteristics for the telematic file transfer within the teletex service".

[15] ITU-T Recommendation T.62: "Control procedures for teletex and Group 4 facsimile services".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETR, the following definitions apply:

Basic requirements: the requirements regarding the functionality of the "file transfer over the ISDN", as expressed by EIUF, IMIMG and IMCC. These requirements are the basics of this ETR.

Standardised Simple File Transfer (SSFT) (protocol): the topic of this ETR is the "file transfer over the ISDN". Based on the requirements it has to be simple, based on the purpose of this ETR it can be assumed that it has to be standardised. Therefore, this ETR uses the term "Standardised Simple File Transfer (SSFT)".

3.2 Abbreviations

For the purposes of this ETR, the following abbreviations apply:

ANSI	American National Standards Institute
API	Application Programming Interface
ASN.1	Abstract Syntax Notation No. one
ATS	Abstract Test Suites
BIS	Bearer Independent Service
CCTA	Central Computer and Telecommunications Agency
CGM	Computer Graphics Metafile
CTS	Conformance Testing Services
EDI	Electronic Data Interchange
EIUF	European ISDN User Form
EPHOS	European Procurement Handbook for Open Systems
ETR	ETSI Technical ETR
ETS	European Telecommunication Standard
ETSI	European Telecommunications Standards Institute
EWOS	European Workshop for Open Systems
FTAM	File Transfer Access and Management
FTP	File Transfer Protocol
GOSIP	Government Open Systems Interconnect Profile
I-ETS	Interim European Telecommunication Standard
IMCC	ISDN Management and Co-ordination Committee
IMIMG	ISDN MoU Implementation and Management Group
ISDN	Integrated Services Digital Network
ISDN-PCI	ISDN Programming Communication Interface
ISODE	ISO Development Environment
ISP	International Standardised Profile
LAN	Local Area Network
ODA	Office Document Architecture
OSI	Open Systems Interconnection
PC	Personal Computer
PCI	Programming Communication Interface
PSDN	Packet Switched Data Network
PSPDN	Public Packet Switched Data Network
PSTN	Public Switched Telephone Network
SBV	Syntax Based Videotex
SSFT	Standardised Simple File Transfer Protocol (topic of this ETR)
TE	Terminal Equipment
TSR	Terminate and Stay Resident (program)
WAN	Wide Area Network

4 Protocols compared

Several protocols were identified which could be expected to meet the **"basic requirements"** expressed by EIUF, IMIMG and IMCC. To compare the protocols and to "recommend, if possible, a single protocol stack for file transfer over the ISDN" the requirements were mapped into technical terms (e.g. primitives, handshakes, technical features) to have a neutral basis on which to compare.

As a general term for the protocols compared this ETR uses **"Standardised Simple File Transfer (SSFT)"**. SSFT will finally be the requested single protocol stack.

Due to the tight time scales the concentrated was on the comparison of the following standards:

ETS 300 075: "Terminal Equipment (TE); Videotex processable data [1]".

EN 41216 (ISO/IEC ISP 10607): "Information Technology - International Standardised Profiles AFTnn - File Transfer, Access and Management [11]".

All other file transfer protocols were briefly considered and excluded (see Annex A).

4.1 Positioning of the protocols compared

Both protocols have a different background and have developed under different circumstances. Neither protocol was specifically designed for file transfer over the ISDN. Figure 1 presents a view regarding the evolution of each protocol.

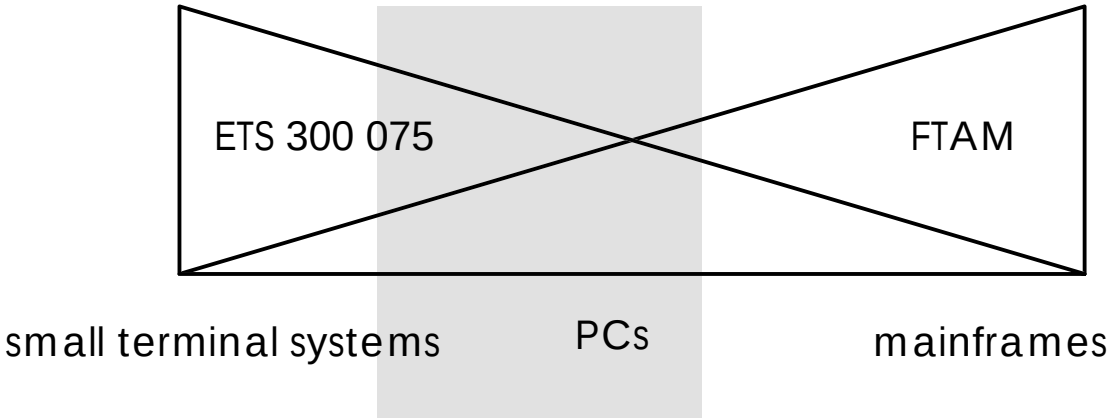

Figure 1: Evolution of ETS 300 075 [1] and FTAM for use in different size computers

Work on ETS 300 075 [1] started in 1987 for Videotex applications using PCs (IBM-compatible, Macintosh, etc.) and even smaller sized terminals like Minitel. Meanwhile, it is used in general purpose file transfer applications and has spread to host systems. The structure of ETS 300 075 [1] is open for enhancements so that compatibility and inter-working with further releases can be guaranteed.

ETS 300 075 [1] does not limit to the size of files as it leaves the file system management to the application level providing a protocol stack independent of the target system. It offers the possibility to use a recovery mechanism, being able to continue an interrupted transfer from a synchronised point.

FTAM (EN 41216 [2]) started as a file transfer protocol between mainframe computers about 7 years ago. Since then, it has developed in two directions: to offer more functionality for more users and to become smaller and more efficient.

FTAM (EN 41216 [2]) was originally conceived as a host-to-host protocol allowing the transfer of files between heterogeneous systems. Nevertheless, it was always recognised that the simplest variant could also be used on smaller systems. However, due to the intrinsic cost of the Open Systems Interconnection (OSI) stack it cannot run sensibly on any machine smaller than a modern PC. Large and small implementations can inter-work after negotiating the sophisticated features on the Association set up.

FTAM has no built-in upper limits on the size of files or their attributes. It uses restart and recovery for very large files to allow a warm start to the middle of a transfer in the event of a crash. The use of unbounded Abstract Syntax Notation No. one (ASN.1) parameters and the expandability of ignoring new "unknown" parameters places no limits on future extendibility of standards or products in an upward compatible fashion.

4.2 File Transfer and OSI layering

File Transfer is one of the layer 7 services defined in the OSI model. If this ETR uses the wording "Standardised Simple File Transfer (SSFT)" it means an **upper layer service** which includes layers 5, 6 and 7. ISO supports this view by defining profiles. Fortunately, the FTAM profiles, ISP 10607 (EN 41216 [2]), correspond to these three layers and, therefore, to ETS 300 075 [1]; therefore we can compare the two protocols in spite of the fact that ETS 300 075 [1] internally has no layered structure.

If we add a **lower layer service** (in other words: a **bearer service**) the result can be seen as a simplified view of the seven-layer-model (see figure 2).

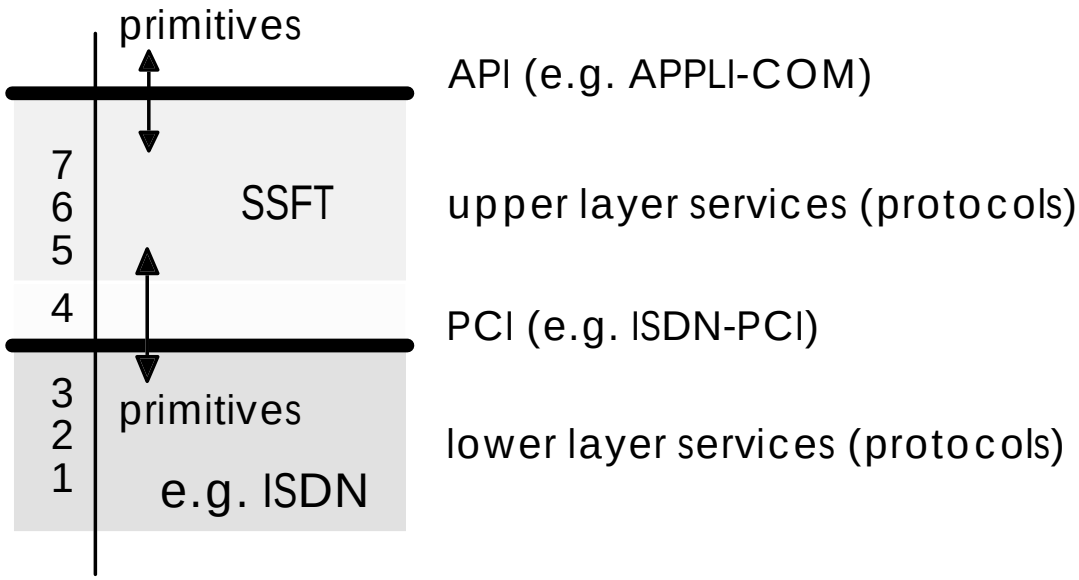

Figure 2: Simplified view of the seven-layer-model

The exact role of layer 4 was unclear during the work on this ETR (see Annex B).

As one of the principles of the OSI model is layering; one layer works independently of any other. This principle implies independent operation of upper layer services and lower layer services. As a consequence, File Transfer (including SSFT) cannot be considered to be applicable just for ISDN.

ETS 300 222 [6] is an example: all Videotex upper layer services (including ETS 300 075 [1]) using the Syntax-Based Videotex (SBV) protocol make use of a Bearer Independent Service (BIS) defined for different types of networks.

The title of the ETR ("file transfer over the ISDN") therefore might, currently, be slightly misleading. Of course, in the second phase of the work, it will be necessary to look into the interactions between upper layers and lower layers in detail.

Even if the task is to concentrate on ISDN then matters will be complicated enough (e.g. X.25 on one B-channel, X.25 on several B-channels, X.25 on a D-channel, ISDN frame relay). On occasions, even the possibility to offer modem pools in the network exchange are discussed. All these variants make sense, particularly if the bearer service provider offers "inter-working" to existing networks.

This ETR therefore neglects bearer dependent aspects of File Transfer, if any. An important prerequisite for this view is the availability of a suitable programming interface towards the lower layers (e.g. ISDN-Programming Communication Interface (ISDN-PCI), see Annex B).

The programming interface towards the application (e.g. APPLI-COM, see Annex B) would be less important if there was only one file transfer protocol to consider. As there are ETS 300 075 [1] and FTAM, EN 41216 [2], this programming interface, together with a common service definition could act integratively towards the user, as described in Clause 8.

Primitives take care of the communication between the layers. Although these primitives are not visible as Protocol Data Units (PDUs) on the line, they are available for the purpose of this ETR: to compare the protocols. Out of obvious reasons the ETR concentrates on the layer 7 primitives (see the subsequent two clauses).

5 Suitability for the basic requirements

As previously mentioned, the basic requirements (current and future) were expressed by EIUF, IMIMG and IMCC. Some of the requirements map to the file transfer protocol, others to the lower layer services, the programming interfaces and the environment needed. Most of the requirements are technical in nature. Some of them are commercially essential for implementations, in particular those referring to the (operating) environment. The project team concentrated on the technical aspects.

The following comparison refers to the working documents (WDs) available to the project team.

5.1 Requirements for the file transfer protocol

Sending and receiving of files mandatory
WD2 (IMIMG) - "Priority list on new ISDN features and applications".
WD4 (France Telecom) - "File Transfer over ISDN".
WD6 (IMCC) - "Short report from IMCC meeting, 25 - 27 May 1992".

Renaming and deleting of distant files optional
WD2 (IMIMG) - "Priority list on new ISDN features and applications".
WD4 (France Telecom) - "File Transfer over ISDN".
WD6 (IMCC) - "Short report from IMCC meeting, 25 - 27 May 1992".

Access to a remote directory with passwords
WD4 (France Telecom) - "File Transfer over ISDN".

Interactive service for the consultation of remote directories
WD2 (IMIMG) - "Priority list on new ISDN features and applications".
WD6 (IMCC) - "Short report from IMCC meeting, 25 - 27 May 1992".

Option free protocol stack
WD1 (ETSI) - "Terms of reference for PT 48 on "File Transfer over the ISDN (Part 1)".

5.2 Comparison of the protocols

The subsequent two subclauses compare the primitives and the handshakes of the protocols. Subclause 5.3 maps the basic requirements for the file transfer protocol directly to the relevant layer 7 primitives. Both protocols allow this mapping; in case of ETS 300 075 [1] the primitives even have the same name as the function required. Both protocols therefore meet the basic requirements.

To try to differentiate in more detail between both protocols, subclause 5.4 and Annex E look into the sequence of primitives (the handshakes) needed to transfer or manipulate a file.

Only the requirement for an **option free protocol stack** needs attention at this point. As the scope and terms of reference for the project team explicitly stated the option free protocol stack to be desirable the question was: what does an option free protocol stack mean? The basic answer the project team found was that probably the defining of a profile for all parameters affected in SSFT and in the lower layers is meant. The second phase of the project team will have to take care of this work.

A totally option free protocol stack might be too limiting, however. For example, FTAM Profile EN 41216 [11] (ISP 10607) guarantees basic inter-working. Even with this profile FTAM offers optional features which can be refused during the parameter negotiation process. It would be a simple matter to fix all

options for use with ISDN, but current implementations, even on PCs, offer some "extras" which it would be unfortunate to lose.

5.3 Comparison of the primitives

Table 1: Comparison of the primitives of ETS 300 075 [1] with the requirements for the file transfer protocol

REQUIREMENTS	PRIMITIVES
Sending of files	T-SAVE (NOTE 1)
Receiving of files	T-LOAD (NOTE 1)
Renaming of files	T-RENAME (NOTE 1)
Deleting of files	T-DELETE (NOTE 1)
Access to a remote directory with passwords	T-DIRECTORY (NOTE 1) Passwords used with T-ASSOCIATE
Interactive service for the consultation of remote directories	Available in combination with ETS 300 223 [7] (NOTE 2)
NOTE 1: This primitive provides for a "designation field" which carries complex search criteria for the consultation of remote directories. NOTE 2: ETS 300 223 [7] provides for the interactive part of the service, ETS 300 075 [1] for the file transfer part.	

Table 2: Comparison of the primitives of FTAM with the requirements for the file transfer protocol

USER SERVICES	PRIMITIVES
Sending of files	F-CREATE (NOTE 1) +F-OPEN+F-WRITE (NOTE 4)
Receiving of files	F-SELECT (NOTE 1) +F-OPEN+F-READ (NOTE 4)
Renaming of files	F-SELECT (NOTE 1) +F-CHANGE-ATTRIBUTE (NOTE 4)
Deleting of files	F-SELECT (NOTE 1) +F-DELETE (NOTE 4)
Access to a remote directory with passwords	F-SELECT (NOTES 1 and 3) or F-CREATE-DIRECTORY (NOTE 2) +F-OPEN (NOTE 4)
Interactive service for the consultation of remote directories	F-SELECT (NOTE 1) +F-OPEN (NOTES 3 and 4)
NOTE 1: FTAM does not define any interpretation for the components of a filename, they provide a transparent naming mechanism to the initiator and the responder of the association. NOTE 2: This service is provided by filestore management (ISO/IEC 8571 [10] Amendment 1). NOTE 3: This service may be provided by NBS-9 document type and it is provided by the filestore management amendment to the FTAM base standards. NOTE 4: Optional filestore password, create password and access password.	

5.4 Comparison of the handshakes

The comparison of the handshakes (see Annex E) once again only shows a similarity in the regime structure, the primitives and the way both protocols provide services. Additionally, as the number of

handshakes for each action is almost the same, one could easily ask whether the two protocols could be aligned (made into one single protocol).

This is not the case. A brief look into the protocol encoding shows that they are so different that protocol alignment seems next to impossible. The facilities offered, and the service primitives used to generate these, give a much more realistic chance of alignment. Subclause 8.2 concludes that it should be possible to develop a service definition and an Application Programming Interface (API) common to both protocols.

5.4.1 Comparison of protocol efficiency

The similarity between both protocol handshakes allows one more conclusion: there is little to prove that one protocol is more efficient than the other.

Additional comments:

ETS 300 075 [1]
Measurements with current implementations have shown an efficiency of 95% (including the file transfer application and the lower layer protocols).

FTAM
In the transfer class there are only three handshakes per transfer, data is **not** acknowledged at layer 7 assuming a reliable transport service. FTAM has outperformed the File Transfer Protocol (FTP) over Ethernet.

5.5 Requirements for the working environment

File transfer products should ...

... be available for a multi-vendor environment
WD3 (EIUF) - "ISDN simple file transfer (Mr. Vanclair)".

... be available in a short term (easy and short implementation)
WD4 (France Telecom) - "File Transfer over ISDN".

... work in a micro computer environment (resources availability)
... work with multipurpose terminals
WD2 (IMIMG) - "Priority list on new ISDN features and applications".
WD4 (France Telecom) - "File Transfer over ISDN".

... be well adapted to the desk office environment (interactive, simple)
WD4 (France Telecom) - "File Transfer over ISDN".
... be easy to use and user friendly
WD3 (EIUF) - "ISDN simple file transfer (Mr. Vanclair)".

These requirements have not been addressed directly, as they closely relate to implementations. The following compares some features of the implementations by using some features derived from the requirements above. Indirectly, Clause 6 also gives some comments.

5.6 Comparison of features derived from the requirements for the working environment

5.6.1 Operating systems supported

This parameter derives from the request for usability in a multivendor environment.

ETS 300 075 [1]
ETS 300 075 [1] is designed to be operating system and file system independent. It is, therefore, designed for the interconnection of heterogeneous multivendor systems. Current implementations for use over ISDN include DOS, OS/2, Mac/OS, Unix and MVS.

FTAM
FTAM is operating system independent. This was one of the prime design criteria. It resulted in the "Virtual Filestore" definition which makes FTAM file system independent. The "Virtual Filestore" describes

an external view presented of a simplistic general purpose filestore. "It is a collection of files ... which have a filename, some attributes and, optionally, contents". The contents may also have a structure. The real filestore can then be mapped locally onto this trivial definition. FTAM is therefore used to drive other bulk transfer mechanisms such as line printers. (single file - write only).

5.6.2 Software size

This parameter derives from the request for a microcomputer environment and for multipurpose terminals. Size of memory for running SSFT, e.g. as a Terminate and Stay Ready (TSR) application, is limited.

ETS 300 075 [1]
Only nine main primitives have to be implemented. The total amount of code for the file transfer application covering layers 4 to 7 is 120 KByte; the core protocol stack currently takes 40 to 80 KByte, dependent on the software supplier.

FTAM
Latest implementations use a "skinny stack" which arose from work in the American National Standard Institute (ANSI) and the European Workshop for Open Systems (EWOS). An implementation by the University of London Computing Centre can run many of the OSI layer 7 applications with 2K lines of code (compared with the 30K+ lines of code in many, if not most, OSI upper layer implementations). This implementation dramatically reduces implementation size by not coding support for options in layers 6 and 5 which FTAM does not use.

5.6.3 User price

This parameter derives from the request for a microcomputer environment and also for multipurpose terminals. SSFT implementations should be competitively priced.

ETS 300 075 [1]
Current implementations for ISDN compare favourably with proprietary packages.

FTAM
FTAM is still relatively expensive from the manufacturers, but is free or in the public domain through the ISO Development Environment (ISODE).

5.6.4 Ease of implementation

This parameter just differs in wording from the requirement "... be available in a short term (easy and short implementation)".

ETS 300 075 [1]
This small size allowed a significant number of software developers to incorporate the stack in their products.

FTAM
FTAM has already been implemented with Application Programming Interfaces (APIs) on every main manufacturer's product, so it need not be re-implemented. There are also portable products, Abstract Syntax Notation No. one (ASN.1) compilers and public domain code to aid new implementors.

5.7 Requirements for the lower layer services

64 kbps unrestricted
WD2 (IMIMG) - "Priority list on new ISDN features and applications".

Typical configuration, first step: ISDN point-to-point
WD3 (EIUF) - "ISDN simple file transfer (Mr. Vanclair)".

Typical configuration, future steps: LANs, inter working ISDN-PSDN, ISDN-PSPDN
WD3 (EIUF) - "ISDN simple file transfer (Mr. Vanclair)".

ETS 300 075 [1] based on X.25
WD2 (IMIMG) - "Priority list on new ISDN features and applications".

ETS 300 075 [1] based on T.90
WD6 (IMCC) - "Short report from IMCC meeting, 25 - 27 May 1992".

All information which is necessary for file transfer is exchanged together with the call set-up; no information shall be exchanged before the call set-up
WD2 (IMIMG) - "Priority list on new ISDN features and applications".
WD6 (IMCC) - "Short report from IMCC meeting, 25 - 27 May 1992".

5.8 Comparison of the interaction with the lower layer services

These interactions have not been examined in detail, as the first assumption was that the lower layers should work independently from the upper layers (and therefore independently from a file transfer protocol). Furthermore, a powerful programming interface like ISDN-PCI (see Annex B) hides the peculiarities of ISDN to the upper layers.

The following compares some technical features derived from the requirements above.

5.8.1 Efficiency

This feature derives from the requirement for "64 kbps unrestricted". Refer to subclause 5.4 which mostly covers this requirement.

5.8.2 Networks supported

This feature derives from the requirement for "Typical configuration, future steps: LANs, inter working ISDN-PSDN, ISDN-PSPDN".

ETS 300 075 [1]
Implementations are already available and used on ISDN, Public Switched Telephone Network (PSTN), Packet Switched Data Network (PSDN), Local Area Network (LAN) to ISDN inter-working.

FTAM
FTAM is network independent. Current implementations run over PSTN, PSDN, Ethernet, Token Ring and other LANs. If a terminal is using ISDN to access a remote non-ISDN network then it needs a defined way to carry FTAM across ISDN even if it is not the preferred solution for ISDN-to-ISDN terminal.

6 Suitability for enhanced requirements

The comparison of suitability for the basic requirements did not show obvious differences between both protocols. To make the differences more apparent a list of comments regarding protocol features generally considered to be important was compiled.

6.1 Comments regarding the file transfer protocol

6.1.1 Security

As SSFT is to be used widely, at least a minimum security mechanism is needed for remote access.

ETS 300 075 [1]
Basic feature with the ASSOCIATE-REQUEST primitive. The protocol leaves the implementation of more complete features (like authentication) to the application and is open to provide more specific parameters if needed.

FTAM
FTAM currently offers protection on both user and individual files. An Access Control Vector is maintained per file. Additional security features are to be added such as file labelling and exclusion lists (due 1994).

6.1.2 Compression

A smaller file allows for faster transfer; therefore compression mechanisms are in widespread use with PC based communication software.

ETS 300 075 [1]
Currently the protocol is enhanced by the definition of V.42bis as standard compression algorithm (private algorithm optional). ETSI is waiting for an answer from the ITU regarding a licence agreement.

FTAM
Compression can be done by either the user application above the SSFT, or by the use of a specific document type with a transfer syntax which ensures that the Presentation layer performs the encoding according to the compression or enciphering algorithm required (e.g. V.42bis as optional private algorithm). The INTAP-1 Record File FTAM Document Type, defined in EN 41216-2 [11] may support compression of data.

6.1.3 Videotex support

As many European Operators have already implemented Videotex offering interactive and file transfer services, compatibility with these services is desirable.

ETS 300 075 [1]
The background of ETS 300 075 [1] is Videotex. It provides all facilities for Videotex in a compatible "TDU layer" incorporating all necessary specific parameters. There also is a "DDU layer" which is not needed over ISDN.

FTAM
Videotex is not currently supported.

6.1.4 Wild card matching

Wild card matching is a feature increasing the efficiency of remote directory searches.

ETS 300 075 [1]
Wild card matching is available on the basis of a designation field of a directory request.

FTAM
Base FTAM allows anything to be carried and matching is a local matter. The FTAM Filestore Management amendment (ISO/IEC 8571 [10] DAM1) defines a full wild card mechanism and the capability for "fuzzy searching", but no products exist yet.

6.1.5 Migration

Upward compatibility with new protocol versions is essential.

ETS 300 075 [1]
ETS 300 075 [1] offers compatibility with future enhancements by authorising new parameters to be included.

FTAM
The FTAM standard (ISO/IEC 8571 [10]) and its amendments offer a wide range of negotiable optional extras. These are upward compatible and, thus, migration is painless.

6.1.6 Recovery

Mechanism to avoid retransmission of the whole file in case of a transfer error.

ETS 300 075 [1]
ETS 300 075 [1] offers a recovery mechanism.

FTAM
FTAM (ISO/IEC 8571 [10]) offers a complete set of warm start crash recovery mechanisms.

6.1.7 Application Programming Interface (API)

SSFT has to be compatible with future standards like APPLI-COM.

ETS 300 075 [1]
Apart from already existing vendor APIs, national recommendations have been defined and currently are being implemented. As soon as standard APIs arrive, implementations of the standard will follow.

FTAM
There are already vendor APIs available for FTAM . When standard APIs become available they will be implemented.

6.2 Comments regarding the working environment

6.2.1 Products

Available products are the answer to short term needs.

ETS 300 075 [1]
In the ISDN-market more than 14 products (software kernels for file transfer) for PCs and Macintosh computers are available. Some are available for IBM and HP computers. In the non-ISDN-market products are available for IBM and Bull.

FTAM
A survey of most major computer manufacturers and software houses was instigated by the UK Treasury (Central Computer and Telecommunications Agency - CCTA) and the Department of Trade and Industry. This is updated and published regularly and gives details of all known OSI products. It describes their level of facility support, operating systems and hardware platforms and claims of conformance to UK and US Government Open Systems Interconnection Profiles (GOSIPs). The last issue listed 76 FTAM products. All support simple transfer and almost 90% support management. FTAM operates today on a variety of X.25 cards, but there are no known users over ISDN.

Systems supported range from IBM hosts running VM, XA or MVS, through the ubiquitous UNIX (Ultrix/POSIX/XENIX/etc.) systems to Macintosh and MS-DOS on PCs and printer driver support. Every major manufacturer now has a GOSIP compliant product for almost all of their machine ranges. There are, in addition, portable versions from companies such as Retix and Wollongong.

6.2.2 Public operator support

Support from the public operators is needed too ensure the success of the idea of SSFT for the anticipated market. Annex D gives additional information.

ETS 300 075 [1]
To achieve compatible solutions the EC Commission has initiated support from the leading ISDN operators France Telecom, DPB Telecom and British Telecom. "Eurofile Transfer" is the name of a marketable software product and a practical application of ETS 300 075 [1] over ISDN.

FTAM
Norwegian, British and Japanese public operators were involved in the development of the FTAM standard (ISO/IEC 8571 [10]). British Telecom are also working on FTAM conformance testing as members of EWOS Project Team 15.

6.2.3 Manufacturer support

Support from the manufacturers is needed to ensure the availability of SSFT on mini-computers and on mainframe systems.

ETS 300 075 [1]
Olivetti (France) has agreed on "Eurofile Transfer". Toshiba (France) confirmed an interest in "Eurofile transfer".

FTAM
The manufacturers have developed FTAM. FTAM is, therefore, available from all major manufacturers.

6.2.4 Conformance testing

Conformance testing shall assure product compatibility.

ETS 300 075 [1]
Conformance testing tools for ETS 300 075 [1] were introduced at the EUIF meeting in October 1992. The corresponding conformance tests are part of the Teledisk specification of France Telecom.

FTAM
EC Commission funded Conformance Testing Services (CTS) projects and an EWOS project which defined a standard Abstract Test Suite (ATS) for FTAM. Furthermore, the EC Commission set up test centres in many member countries all using the same tests and tools to permit consistent testing and approval across Europe (and world-wide - USA and Japan also use this ATS).

6.2.5 Implementation guideline

To complete the recommendation of a protocol it is necessary to provide an implementation guideline.

ETS 300 075 [1]
An existing implementation guideline is available with the Teledisquette specification of France Telecom. This type of guideline specifies all the necessary profiles to ensure interoperability between any products available on the market.

FTAM
The International Standardised Profile (ISP) for Simple File Transfer defined in EN 41216 [11] (ISP 10607) is further refined in GOSIP and the first version of the Commission's European Procurement Handbook for Open Systems (EPHOS). UK GOSIP gives guidelines for both procurers and implementors.

7 Service class for Standardised Simple File Transfer (SSFT)

The two different views have been expressed on the basic service class which should be assigned to SSFT:

- SSFT is a teleservice;
- SSFT is a terminal application of a bearer service.

No decision has been made as to which of the service classes applies. From a technical point of view, it does not matter: the protocol stack is not affected.

Both assignments seem possible:

- if a precise service definition exists which covers SSFT, other upper layer services and the user interface, then there is reason to speak of a teleservice. Videotex is an example;

- if the service definition for the upper layers (e.g. for SSFT) is left to the terminals (PCs), then there is reason to speak of a terminal application of a bearer service.

8 Conclusions and recommendations

Based on the **basic** requirements, both protocols look technically so similar that it is hardly possible to recommend which protocol to select. If immediate availability of implementations is an issue, the impression is that FTAM (ISO/IEC 8571 [10]) implementations operate on a variety of X.25 and LAN cards but without known users over ISDN. ETS 300 075 [1] implementations do work over ISDN as well as over PSTN and PSDN.

Based on the comparison of suitability for **enhanced** requirements, ETS 300 075 [1] and FTAM (ISO/IEC 8571 [10]) look technically more different: FTAM (ISO/IEC 8571 [10]) gives an extensive range of optional extra facilities based on file access and file management, ETS 300 075 [1] gives facilities based on application management.

The range of optional extra facilities FTAM provides could be of interest to terminal users even for SSFT. It provides the ability to read file attributes (e.g. file size), change some attributes (e.g. access control), do

concurrency control, etc. With the full FTAM capabilities negotiated one can create and delete files, read and change file attributes, read and write parts of the file, use concurrency control on a file or record level, use access control on the file actions, etc. The amendments to the Base Standards include filestore management (i.e. creation and deletion of directories), service enhancements and overlapped access.

ETS 300 075 [1] has the ability to change control and therefore to provide a symmetric service, has support for Videotex, has the ability to manage names of telesoftware applications, etc. This range of services is closer to application management.

The following possibilities are therefore proposed for consideration.

8.1 Immediate decision for one of the existing protocols

Either protocol can be selected from a purely technical point of view and by just considering the basic requirements.

What seem to be only slight technical differences can, of course, be expanded if enhanced requirements or issues like immediate availability of implementations for ISDN are introduced. Although the ETR lists such issues it does not draw conclusions as this is outside the scope of the ETR.

8.1.1 Consequences

An immediate decision answers most urgent market needs. Either selection of one protocol stack will cause incompatibility with existing implementations of the other. Either selection will cause specific problems. Either selection will favour a specific market segment according to the current positioning of the file transfer protocols. Either selection will lose the advantages which the other selection possibly could provide. Later migration from one protocol to the other will be difficult.

8.1.2 Project work for phase 2

As already planned for the Project Team, to be known as TEAM1, an ETS is to be produced which covers the following technical items:

- selection of lower layer protocol parameters;

- selection of parameters carried by lower layer protocols (e.g. code points for HLC, LLC, ...) in liaison with ETSI STC-SPS5;

- selection of facilities offered by the file transfer protocol;

- selection of the appropriate parameter values with the aim to have, if possible, an option free kernel protocol;

- although some equipment complying with the ETS could be built without taking care of any API, it is necessary that the ISDN file transfer protocol relation with both the ISDN-PCI and APPLI-COM is defined. As far as APPLI-COM is concerned, this may lead to specific requests of the definition of APPLI-COM.

Additionally, conformance test specifications should be produced by another Project Team (referred to as TEAM 3).

Duration: 6 months.

Effort (necessary manpower):
4 man-months (as already planned for TEAM1);
20 man-months for the conformance test specifications (for TEAM3).

8.2 Decision for one of the existing protocols with added flexibility

To add flexibility, a service definition and an API common to both protocols should be developed.

There are great similarities in the primitives and the basic services the protocols offer to the application. It should therefore be possible, in a first stage, to derive a common "core" set of functions and to define these in either an OSI Service definition (as defined in ISO TR 8509 [12]) or as an API (e.g. APPLI-COM). A second stage would be to extend this core, align the service definitions and merge them into a single service to any application.

With the availability of a common service definition and a common API (but still two protocols in use) either one of the two protocols can be selected without disrupting the service for the users of the other protocol stack.

With this flexibility added a decision could be made now as well as later. The time needed to develop a common service definition and a common API could be used to prepare more precise decision criteria for the selection of one single protocol stack.

8.2.1 Consequences

Using this approach the service to the user is independent from the protocol used. Therefore either protocol could be selected without disrupting the use of the other. Additionally, the possibility exists for the user to transparently migrate from one protocol to the other. Implementations might even allow for both protocol stacks to coexist.

8.2.2 Project work for phase 2

As already planned (see subclause 8.1.2). Additionally, it is suggested to add the following technical items. These items should be covered by another project team (referred to as TEAM2):

- provide a service definition common to both protocols;
- provide an API common to both protocols taking into consideration current work on APPLI-COM;
- define the inter-networking rules, options and constraints;
- plus the items to be covered by TEAM3 (see subclause 8.1.2);
- provide conformance test specifications.

Duration: 8 months

Effort (necessary manpower):
4 man-months (as already planned for TEAM1);
plus 3 man-months for TEAM1 to achieve alignment with TEAM2 and TEAM3;
6 man-months for the common service definition (for TEAM2);
8 man-months for the common API (for TEAM2);
4 man-months for inter networking (for TEAM2);
20 man-months for the conformance test specifications (for TEAM3).

8.3 Decision for a completely new protocol

Technically it would be ideal to arrive at one single protocol stack by defining a new service combining the best of both protocols.

For technical reasons this goal may not be realisable. Although both protocols show a remarkable similarity in the core features and in the regime structure, the methods of encoding are completely different. ETS 300 075 [1] specifies its encoding within the document whereas FTAM (ISO/IEC 8571 [10]) makes use of ASN.1 (X.208) to define its Protocol Data Units (PDUs) and of the Basic Encoding Rules (X.209) to encode them. This means that the actual protocols are completely incompatible and could not simply be "merged". Even if one succeeded, the resulting protocol would be completely new.

8.3.1 Consequences

The best of both protocols is combined, backward compatibility with both existing protocols is maintained in one single protocol stack. However, one more file transfer protocol is born; however, the required manpower is very high (man-years).

8.3.2 Project work for phase 2

Not recommended.

8.4 Final recommendation

Three alternatives are put forward for decision:

Alternative 1

Due to the urgent market need, proceed as described in subclause 8.1 and make the decision for one single protocol stack **now**.

Alternative 2

Respond to the urgent market need and decide for one single protocol stack **now**. In order to avoid disruption of service to existing users, proceed as described in subclause 8.2 and decide for the development of a common service definition and a common API **now**.

Alternative 3

As alternative 2, but decide for one single protocol stack **later**. Use the time during which a common service and a common API are developed for defining these more precise technical decision criteria.

Annex A (informative): File transfer protocols *excluded*

This annex lists those file transfer protocols which were excluded from comparison after brief consideration.

A.1 Teletex

ETS 300 081 [4] "**Integrated Services Digital Network (ISDN); Teletex end-to-end protocol over the ISDN**" was excluded, as it does not meet some basic requirements.

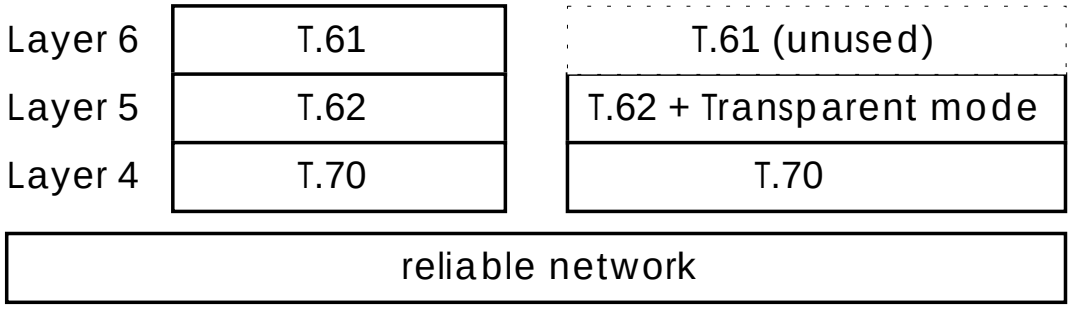

Figure 3: CCITT Recommendations T.61, T.62 and T.70 define the Teletex Protocol stack (layers 4 to 6 for basic Teletex and for Teletex using "transparent mode")

Teletex was originally designed for exchanging special text documents in a designated format, using the character sets defined by ITU-T Recommendation T.61 [13]. It guarantees maintaining the same layout of documents on sending and receiving side. To fulfil this task, basic Teletex equipment has to ensure that no other documents are passed to the network. Due to this restriction there is no possibility for simply exchanging binary files in the basic Teletex environment. Considering this situation ITU-T (formerly CCITT) and ETSI have extended the basic functionality of Teletex by introducing "transparent mode" defined in ITU-T Recommendation T.571 [14] and ETS 300 154 [5], offering Teletex equipment the possibility to exchange transparent data and therefore generally to be used for file transfer applications.

The facilities of the ITU-T Recommendation T.62 [15] session protocol are not very powerful. It mainly offers the possibility to send a document. The permission for this operation depends on the role currently assigned to the entity. Therefore only the master, initially the originator of a connection has the permission for sending a document. Since ITU-T Recommendation T.62 [15] defines a symmetrical service, it offers the ability to change roles between master and slave, whereby the recipient is also able to send a document to the originator.

In addition to these basic facilities, Teletex offers the opportunity to download documents by using an indirect, sophisticated mechanism of first sending a control document containing all relevant information for the downloading procedure and afterwards changing the role enabling the other side to send the specified document. Since "transparent mode's" definition only supplements existing session protocol elements by additional parameters no additional features or possibilities as these just mentioned are offered when using "transparent mode".

Teletex today does not meet the basic requirements as it does not offer the ability of downloading a directory, of renaming and deleting a document and of downloading a document in a simple manner. Further effort would be necessary to extend Teletex to fulfil these requirements. Such additional effort does not make sense because other protocols, able to satisfy these requirements are already available. Using Teletex instead implies additional delay in realisation of SSFT.

A.2 Telematic file transfer

The protocol stack of T.TFT is obviously very similar to that used for Teletex and facsimile group 4 and is based on the ITU-T Recommendation T.62 [15]. Therefore, the same reason for exclusion applies as for Teletex.

A second reason for exclusion is the alignment work currently being carried out between ETS 300 075 [1] and T.TFT (e.g. the structure of the control document) as ETS 300 075 [1] was included in the comparison.

A.3 Proprietary file transfer

In spite of using proprietary file transfer protocols, current commercial communication packages are in widespread use. Due to their proprietary nature no details were available for consideration.

One reason for their widespread use in the PC market is price. Even if it might not be necessary for SSFT implementations to compete pricewise with freeware or shareware products, it will be necessary that their price stays in an acceptable relation.

One point which is worthy of consideration is that most of current communication packages use asynchronous transmission. Solely because of start bits and stop bits, 20% of the bandwidth of a line is wasted. Synchronous protocols like those used for file transfer over the ISDN have much lower overheads (in the order of a few percent).

Annex B (informative): Programming Communication Interfaces (PCI) for SSFT

B.1 Application Programming Interface (API)

Main purpose of an API is to provide for (application) software portability.

Generally, an API has only little influence on the standardisation of SSFT, since it is possible to forget transportability and to keep things simple. If the goal is a "simple" file transfer protocol, it makes sense to avoid the extra effort of implementing an API and to bundle the file transfer protocol with the application. An example is Videotex software.

Nevertheless there are two reasons for paying full attention to the API later:

- if ease of migration from SSFT to FT (full functionality for file transfer, access and management) is for discussion. FT will have to provide services and an API for applications that come from other vendors;

- it might be desirable to have a common service definition and a common API for both protocol stacks, as described in subclause 8.2.

One possible API is as given in prETS 300 243 [9] which is an endorsement of ITU-T Recommendation T.611 with ETSI common modifications. The corresponding ITU-T Recommendation T.611 takes into account the file transfer like BTM, DTM and Bft.

APPLI-COM provides an internationally standardised API between user applications and communication software. It separates the applications from the communication functions, e.g. by creating and evaluating specific envelopes with a defined set of parameters. Operating on these envelopes, applications have the ability to select e.g. facsimile group 3, facsimile group 4, Teletex and telex in a common and easy way.

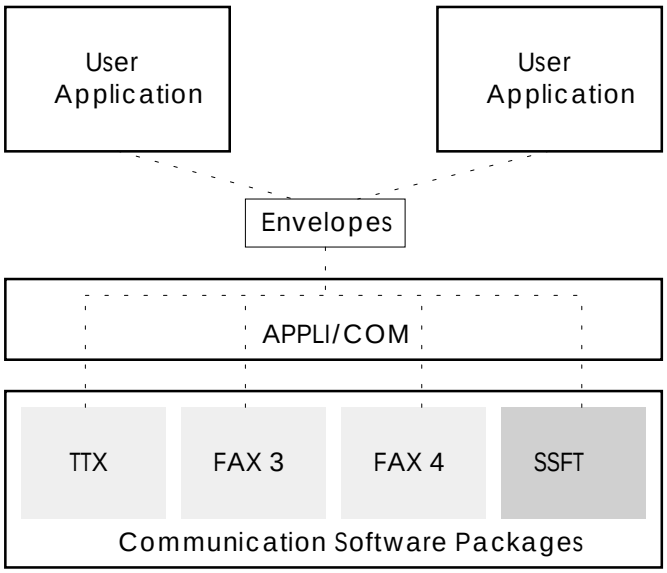

Figure B.1: APPLI-COM, functionality

The applications interface area is currently being developed by ISO, ITU-T and ETSI. It is assumed that when the work is complete, products for both file transfer protocols will appear. For the future work it will be necessary to establish liaisons with ISO/IEC working groups (like ISO IEC/JTC1/SC18/WG4 working on a generalised communications API) and with ETSI STC TE2.

B.2 The role of layer 4

The exact role of level 4 was unclear. Both protocols need this layer to work. If ISDN provides the lower layer services it certainly is sufficient to use the simplest version of layer 4: transport class 0. In the case of ETS 300 075 [1] it is possible to disable layer 4 completely by using the functionality of ETS 300 223 [7] (see figure B.2). For FTAM no comparable functionality seems to be available. This situation does not

necessarily mean that there exists a functional difference between both protocols, but further investigation will be necessary in future work.

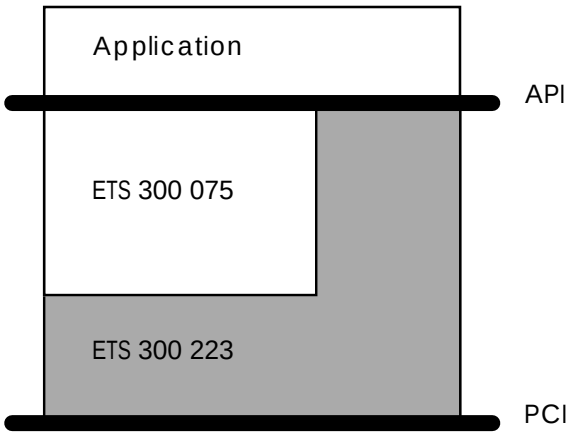

Figure B.2: Layering of ETS 300 075 [1] and ETS 300 223 [7]

Looking at hardware, the exact level of the service provided by an ISDN card and its supporting API is again unclear and could be considered to be either layer 3 or layer 4. The boundary to ISDN is, in any case, complex with several choices of service and it is assumed that these will be hidden by a communications API. This question may need to be studied further in the future work. The remainder of this ETR assumes a Bearer Independent Service (BIS).

B.3 Programming Communications Interface (PCI)

If the boundary between upper and lower layers corresponds to a hardware interface (e.g. an interface card of a personal computer) then it usually manifests itself in a programming interface. Although initially neglected, much standardisation effort is now being carried out into such interfaces.

The availability of such an interface is the prerequisite to achieve hardware independence. This means that, for example, a SSFT software product can be sold or bought independently of the interface card (manufacturer, network). An example is ETS 300 325 [8].

The ISDN-PCI has been defined in order to provide an international standardised programming interface between ISDN applications and ISDN adapter boards, especially to access EuroISDN, but also offering the ability to support existing ISDN implementations. Therefore, the ISDN PCI is intended to be provided by ISDN adapter manufacturers instead of their private programming interfaces. This improves the portability of applications that use the ISDN-PCI across the range of different ISDN adapter boards and different operating systems.

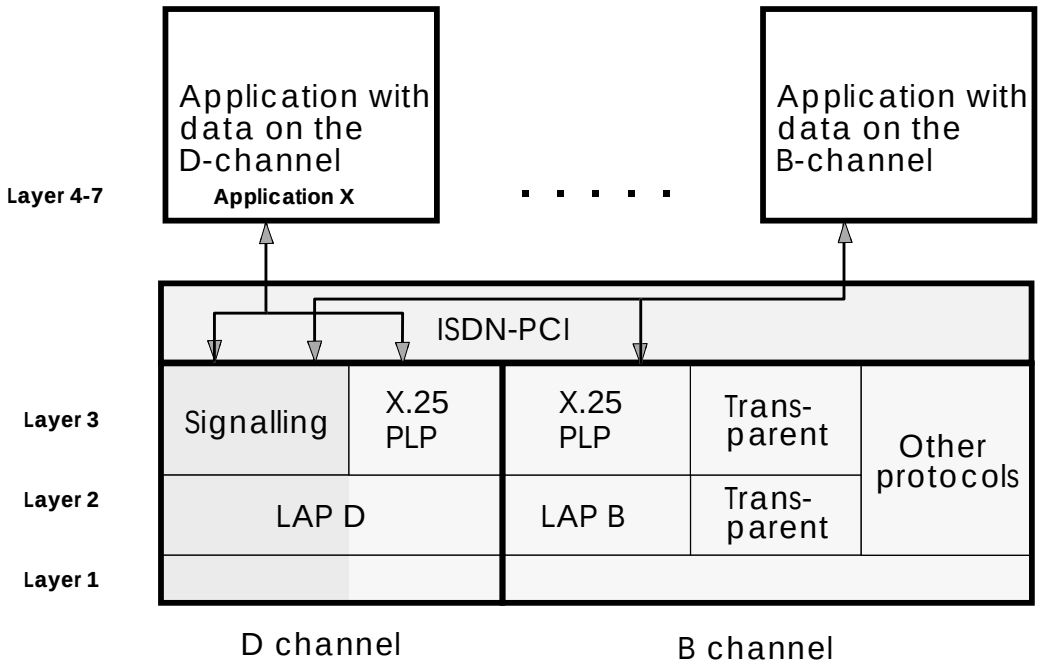

Figure B.3: ISDN-PCI, functionality

In the OSI reference model the ISDN-PCI is located at the boundary between layer 3 and layer 4. Full layer 3 functions, such as signalling and access to supplementary services are available for applications co-operating with the ISDN-PCI.

The meaning of the ISDN PCI is strictly local and has, in this sense, no end-to-end significance. Its primary task is only administering, co-ordinating and managing the access to the limited range of resources e.g. D- and B-channels, shared between multiple applications operating on ISDN. Therefore, the ISDN-PCI basically only offers defined procedures for accessing lower layer protocol services as well on the D- as on the B-channels.

With regard to the file transfer standardisation the ISDN-PCI generally has no influence, because a compatible file transfer application may also be realised without using the ISDN-PCI standardised interface, but many of the advantages just mentioned are lost. Nevertheless, the ISDN-PC cannot be excluded from the file transfer discussion because it defines the mandatory set of protocols to be offered by all ISDN adapter manufacturers in their specific ISDN-PCI implementation. Therefore, when defining the lower layers for SSFT these protocols shall be defined as mandatory in the ISDN-PCI otherwise ISDN adapter manufacturers are free to implement them and file transfer is only able to run on ISDN adapter boards which offer these optional protocols.

Liaison with ETSI STC-TE2 who are working on ISDN-PCI will be necessary during further work.

Annex C (informative): FTAM - a brief overview

File Transfer Access and Management (FTAM - ISO/IEC 8571 [10]) was published in 1988. It is a mature standard defining a family of protocols. These range from a simple protocol which can transfer whole files transparently (with optional file management) in a very efficient manner to an access protocol which offers sophisticated database style operation.

A recent survey listed 76 products, ranging from simple, minimal PC versions to full feature host/server systems. All major computer manufacturers have products. The second group of products are now more compact and more user friendly. FTAM makes full use of the Presentation layer to allow translation (e.g. between different character sets). It was designed to operate over any reliable duplex bit pipe and is currently run mainly over X.25 Wide Area Networks (WANs) and a variety of Local Area Networks (LANs) such as Ethernet. The style of operation of FTAM (simple transfer or full record access) is negotiated at Association set-up.

It is clear that the ETSI needs for Simple File Transfer would be met best by using the File Transfer and Management class. This is refined in the International Standardised Profiles (ISP) EN 41216 [11], Parts 3 and 6 and is also the style most commonly implemented, used and mandated by the European Commission in EPHOS version 1.

This FTAM class offers the following services:

FTAM regime establishment	
FTAM regime termination	orderly or abrupt
File selection	
File deselection	
File create	
File delete	
File open	
File close	
File read	see NOTE
File write	see NOTE
Read attributes	
Change attributes	optional, implies Rename (= change the attribute "filename")
Read directory	optional, supported by the document type NBS-9
Regime recovery	optional
Restarting data transfer	optional
Checkpointing	optional

NOTE: At least one operation is supported.

In addition, FTAM has a large number of additional features which can be negotiated. These include, as an example, file concurrency control and record locking, file access control, document types supported and file attributes supported.

As terminals become more powerful and have more memory, it will be possible to implement the additional features of FTAM in an upward compatible manner. Thus the next generation of terminals will not be restricted to whole file transfer only.

A range of file types have been defined as document types within the FTAM Base Standard ISO/IEC 8571 [10] (i.e. document type FTAM-1 is an unstructured text file) or within the EN 41216 [11], Part 2 and its amendment 1 (i.e. NBS-9 is a directory file). An other example is the Computer Graphics Metafile (CGM) which allows individual picture frames to be read without a complete file being transferred. Further examples are Electronic Document Interchange (EDI) and Office Document Architecture (ODA) for which FTAM support is being planned. Four amendments to FTAM have been developed to further increase facilities. All of these are optional additions negotiated at start-up, and include remote Filestore management.

The full set of possible facilities in addition to the above are:

Access record or field using Read, Insert, Replace, Extend, Locate or Erase	
Create Directory	Delete Directory
Read Directory	Change Directory
Create Reference	Delete Reference (Alias)
Select Group of files by their Attributes (e.g. select all files over 1 MByte belonging to Peter and not accessed for a month)	Select additional security mechanisms
Move group of files	Copy group of files (within remote system)
Select ability to read and write simultaneously	Select Multiple Associations per connection

FTAM can, therefore, offer a simple file transfer today and the option to migrate to powerful capabilities over a range of networks in the near future.

Annex D (informative): Public operator support

Although already covered by an IMIMG statement which contributed to the production of this ETR, this annex lists supporting statements of public operators which arrived during the preparation of this ETR. The list is intended as additional information.

Table D.1: Public operator support

Public Operator	Need of a SSFT on ISDN	Comments
Austrian PTT	Yes	
Finland	Yes	
Telecom Portugal	Yes	Eurofile Support
Norwegian Telecom	Yes	Plan for implementing ETS 300 075 [1] + Teledisk
British Telecom	Yes	Eurofile Support
DB TeleKom	Yes	Eurofile Support
France Telecom	Yes	Eurofile Support
Jydsk Telefon	Yes	

"Eurofile Transfer" is the version of the European standard ETS 300 075 [1] used on market-adapted ISDN software products for open file transfer. The EC-Commission, with the support of leading ISDN operators, has taken the initiative of having harmonised, i.e. compatible solutions developed. In co-operation with ISDN-experienced companies a product family is being developed which can be adapted to different system environments and communication interfaces.

Annex E (informative): Comparison of the protocol handshakes required to satisfy the basic requirements

NOTE: In the following,"+" (the plus-sign) indicates a grouping of primitives.

E.1 ETS 300 075 - Send

```
-->     T-ASSOCIATE-request
   <--  T-ASSOCIATE-response
-->     T-ACCESS-request
   <--  T-ACCESS-response
-------------------------------------------------------------------------------------------------------------
-->     T-SAVE-request
   <--  T-SAVE-response
-->     T-WRITE-request (data)
             :
-->     T-WRITE-END-request (data)
-------------------------------------------------------------------------------------------------------------
-->     T-END-ACCESS-request
   <--  T-END-ACCESS-response
-->     T-RELEASE-request
   <--  T-RELEASE-response
```

E.2 FTAM - Send

```
-->     F-INITIALIZE-request
   <--  F-INITIALIZE-response
-------------------------------------------------------------------------------------------------------------
-->     F-CREATE-request + F-OPEN-request
   <--  F-CREATE-response + F-OPEN-response
-->     F-WRITE-request
-->     F-DATA-request
             :
-->     F-DATA-END-request
-->     F-TRANSFER-END-request
   <--  F-TRANSFER-END-response
-->     F-CLOSE-request + F-DESELECT-request
   <--  F-CLOSE-response + F-DESELECT-response
-------------------------------------------------------------------------------------------------------------
-->     F-TERMINATE-request
   <--  F-TERMINATE-response
```

E.3 ETS 300 075 - Receive

```
-->         T-ASSOCIATE-request
      <--   T-ASSOCIATE-response
-->         T-ACCESS-request
      <--   T-ACCESS-response
-------------------------------------------------------------------------------------------------------------
-->         T-LOAD-request
      <--   T-LOAD-response
      <--   T-WRITE-request (data)
                  :
      <--   T-WRITE-END-request (data)
-------------------------------------------------------------------------------------------------------------
-->         T-END-ACCESS-request
      <--   T-END-ACCESS-response
-->         T-RELEASE-request
      <--   T-RELEASE-response
```

E.4 FTAM - Receive

```
-->         F-INITIALIZE-request
      <--   F-INITIALIZE-response
-------------------------------------------------------------------------------------------------------------
-->         F-SELECT-request + F-OPEN-request
      <--   F-SELECT-response + F-OPEN-response
-->         F-READ-request
      <--   F-DATA-request
                  :
      <--   F-DATA-END-request
-->         F-TRANSFER-END-request
      <--   F-TRANSFER-END-response
-->         F-CLOSE-request + F-DESELECT-request
      <--   F-CLOSE-response + F-DESELECT-response
-------------------------------------------------------------------------------------------------------------
-->         F-TERMINATE-request
      <--   F-TERMINATE-response
```

E.5 ETS 300 075 - Directory list

```
-->       T-ASSOCIATE-request
     <--  T-ASSOCIATE-response
-->       T-ACCESS-request
     <--  T-ACCESS-response
-------------------------------------------------------------------------------------------------------
-->       T-DIRECTORY-request
     <--  T-DIRECTORY-response
     <--  T-WRITE-request (directory data)
               :
     <--  T-WRITE-END-request (directory data)
-------------------------------------------------------------------------------------------------------
-->       T-END-ACCESS-request
     <--  T-END-ACCESS-response
-->       T-RELEASE-request
     <--  T-RELEASE-response
```

E.6 FTAM - Directory list

```
-->       F-INITIALIZE-request
     <--  F-INITIALIZE-response
-------------------------------------------------------------------------------------------------------
-->       F-SELECT-request + F-OPEN-request
     <--  F-SELECT-response + F-OPEN-response
-->       F-READ-request
     <--  F-DATA-request (directory data)
               :
     <--  F-DATA-END-request (directory data)
-->       F-TRANSFER-END-request
     <--  F-TRANSFER-END-response
-->       F-CLOSE-request + F-DESELECT-request
     <--  F-CLOSE-response + F-DESELECT-response
-------------------------------------------------------------------------------------------------------
-->       F-TERMINATE-request
     <--  F-TERMINATE-response
```

NOTE: Directory data is a special document type (NBS-9); alternatively FTAM can be enhanced by amendment 1.

E.7 ETS 300 075 - Rename

```
-->         T-ASSOCIATE-request
      <--   T-ASSOCIATE-response
-->         T-ACCESS-request
      <--   T-ACCESS-response
-------------------------------------------------------------------------------------------------------------
-->         T-RENAME-request
      <--   T-RENAME-response
-------------------------------------------------------------------------------------------------------------
-->         T-END-ACCESS-request
      <--   T-END-ACCESS-response
-->         T-RELEASE-request
      <--   T-RELEASE-response
```

E.8 FTAM - Rename

```
-->         F-INITIALIZE-request
      <--   F-INITIALIZE-response
-------------------------------------------------------------------------------------------------------------
-->         F-SELECT-request
              + F-CHANGE-ATTRIBUTE-request
              + F-DESELECT-request
      <--   F-SELECT-response
              + F-CHANGE-ATTRIBUTE-response
              + F-DESELECT-response
-------------------------------------------------------------------------------------------------------------
-->         F-TERMINATE-request
      <--   F-TERMINATE-response
```

E.9 ETS 300 075 - Delete

```
-->         T-ASSOCIATE-request
      <--   T-ASSOCIATE-response
-->         T-ACCESS-request
      <--   T-ACCESS-response
-------------------------------------------------------------------------------------------------------------
-->         T-DELETE-request
      <--   T-DELETE-response
-------------------------------------------------------------------------------------------------------------
-->         T-END-ACCESS-request
      <--   T-END-ACCESS-response
-->         T-RELEASE-request
      <--   T-RELEASE-response
```

E.10 FTAM - Delete

```
-->         F-INITIALIZE-request
      <--   F-INITIALIZE-response
-------------------------------------------------------------------------------------------------------------
-->         F-SELECT-request + F-DELETE-request
      <--   F-SELECT-response + F-DELETE-response
-------------------------------------------------------------------------------------------------------------
-->         F-TERMINATE-request
      <--   F-TERMINATE-response
```

E.11 Summary

The above comparison once again only serves to show a similarity in the way the services are provided and of the regime structure and primitives. The number of handshakes for each action is almost the same for each case, so there is little to prove that one is more efficient than the other.

However, it has again to be stressed that the encodings are very different. Due to insufficient time it was not possible to compare encodings in detail but only to note that the protocols could not be aligned. The facilities offered, and the primitive service used to generate these give a much more realistic chance of alignment.

History

Document history	
September 1993	First Edition
January 1996	Converted into Adobe Acrobat Portable Document Format (PDF)