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interfaces at the network side of the NT1**

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Foreword

This ETSI Technical Report (ETR) has been produced by the Network Aspects (NA); 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 the application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or an I-ETS.

From a technical point of view, it is often convenient to consider public and private network aspects at the same time. This ETR includes some such discussion and conclusions regarding private network applications, but this is not complete and does not form part of ETSI's response to the Study and Investigation mandate BC T 030 SI from the EC.

Introduction

This ETR presents the results of the Task Force created by the ETSI Technical Committee NA to analyse the impact and the technical feasibility of creating a new interface at the network side of the NT1, as requested by the Study and Investigation mandate BC-T-030-SI from the EC.

This Task Force was created during the TC/NA plenary meeting (Stockholm 5-8 May 1992) and held four meetings whose reports have been published and distributed according to the TC/NA mailing list.

The Task Force is chaired by F. Lucas (FRANCE TELECOM) Vice Chairman of TC/NA.

The discussions inside the group, which was composed of representatives from network operators and manufacturers from public switching and from private networks, were at first concentrated on the basic rate access whose results are given in Clauses 2 to 6. The primary rate access was also considered and the results are given in Clause 7. This ETR constitutes the final technical answer to the existing EC mandate given to ETSI. However, in addition, ETSI have also started additional studies in relation with the economical studies performed by OVUM on behalf of the European Commission, those additional pieces of information are given in Clause 6.

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1 Scope

This ETSI Technical Report (ETR) presents the results of the Task Force created by the ETSI Technical Committee NA to analyse the impact and the technical feasibility of creating a new interface at the network side of the NT1, as requested by the Study and Investigation mandate BC-T-030-SI from the European Commission (EC).

2 Situation of standards

2.1 Situation on standardisation in CCITT

Study Group XVIII worked on a question "Network side of the NT1" during study period 1985 to 1988 which was put in by the USA. The term "U-interface" was commonly used although a U reference point did not exist in any CCITT Recommendation and is still not defined.

Two Recommendations were agreed at the end of the study period:

- CCITT Recommendation G.960: "Digital section for ISDN basic rate access", and
- CCITT Recommendation G.961: "Digital transmission system on metallic local lines".

CCITT Recommendation G.960 was relatively complete and consistent but some paragraphs were fairly general and not sufficient for implementation, i.e. operation and maintenance, control channel requirements.

The quality of CCITT Recommendation G.961 was very similar. While the definition of the transmission medium and the system performance requirements were well advanced, the requirements concerning operation and maintenance, power feeding and environmental conditions were only general and not specific enough.

CCITT Recommendation G.961 contained 6 Appendices each describing a transmission system.

The study continued on both CCITT Recommendations during the Study period 1989 to 1992 and both were revised and agreed at the final meeting in June 1992.

The requirements for activation/deactivation in CCITT Recommendation G.960 were enhanced according to some national specific requirements. Due to the little progress made on the operation and maintenance the long list of items was reduced to the minimum requirements with some general definitions leaving room for the national requirements based on them.

Concerning CCITT Recommendation G.961, the number of Appendices was reduced to 4, but concerning all the other requirements no real progress was possible. A proposal to change the Appendices into Annexes was rejected by a large number of countries. The Appendices were restructured by defining core requirements, related to transmission characteristics and minimum capabilities and the extension requirements which list further capabilities and characteristics for national use.

2.2 Situation on standardisation in ETSI

ETSI Sub Technical Committee (STC) TM3 started in April 1990 to specify an ETS on the basic rate access digital section (ETS 300 297) which is based in CCITT Recommendation G.960 and produced an ETR on the basic rate digital transmission system on metallic local lines (ETR 080). ETR 080 was based on a former CEPT Recommendation and CCITT Recommendation G.961.

ETS 300 297 is nearly identical to CCITT Recommendation G.960 as agreed at the June meeting of Study Group XVIII. ETS 300 297 was agreed by TM3 in March 1992 and by TM (by correspondence) in September 1992. The differences to CCITT Recommendation G.960 (1992) are minor.

ETR 080 was finished and agreed by TM3 in October 1992 and has been sent to TM for approval by correspondence. The main part is quite different to CCITT Recommendation G.961 (1992) it contains more detailed information on the network transmission medium and widely revised system performance definitions and test requirements. It takes into account the special European situation much better than CCITT Recommendation G.961. Operation and maintenance requirements are more or less the same as in CCITT Recommendation G.961, while power feeding and environmental condition requirements are well advanced compared to CCITT Recommendation G.961.

ETR 080 contains also two Annexes each describing a transmission system (one for 2B1Q and one for 4B3T) which are the core requirements as in the relevant appendices in CCITT Recommendation G.961. An appendix to each Annex gives the extension requirements as in CCITT Recommendation G.961. The differences between CCITT Recommendation G.961 and ETR 080 are minor in this respect.

3 Situation worldwide

3.1 Japan

Formally in Japan a U-interface exists. This is as the result of pressure from the USA government and the commercial aspects were not considered. (see also for additional information ETSI/ONP (92)51 source OVUM).

The type of transmission system implemented to suit the Japanese network, uses Time Compression Multiplex (TCM) techniques. All other systems defined in CCITT use Echo Cancellation Hybrid (ECH) transmission system techniques. This results in the situation where there is incompatibility between transmission system Network Termination (NT1). Therefore terminal compatibility is only achieved at the S/T interface as has been defined in CCITT Recommendation I.430 (the European specification equivalent is ETS 300 012).

The Japanese network operator (NTT) has three suppliers of their TCM NT1 which NTT markets as part of a complete package for the INS64 service. To date none of these suppliers have indicated they are prepared to market the NT1 individually as they believe that they could not compete with NTT (small market share, costs, etc.). Therefore, there are no products in the market to compete with NTT.

To date, there are no terminals that have combined NT1 functions, and if they were to become available they would only be compatible with the national U-interface specification in Japan since an international version of a standardised U-interface does not exist. This may be a possible limitation on the marketability of U terminals.

NTT does not sell the NT1 to customers as it rents (leases) the transmission system, which includes maintenance. NTT comment that they would have to overcome considerable problems in defining ownership of responsibility of faults if the NT1 was not supplied by themselves. This is due to the incorporation by NTT of a number of maintenance features in their NT1's to detect faults.

In summary, although Japan has a U-interface there is only international terminal portability at the S/T interface and terminals with combined NT1 functions, if they existed, would only work in Japan. The NT1 is only available from the network operator NTT.

3.2 USA/North America

In February 1991 Bellcore announced National ISDN-1, the first phase of development of an ISDN that allows compliant CPE equipment to work with any vendors' switch that meets the requirements of N1-1. N1-1 being an implementation of the national standards specified by ANSI. Canadian telephone administrations have also adopted N1-1 as the national configuration for basic rate access lines.

The NT1s are manufactured to meet specific requirements for connection to the network, and the functionality provided is the same regardless of it being owned by the telephone administration, an "arms length" subsidiary, or the end user.

The NT1 is normally powered from commercial sources via a wall outlet, with the option of backup battery provided for voice terminals, if required. Exchange remote power feeding is not provided.

NT1 has been developed and implemented by two major North American based switch vendors and by at least one major European based switch vendor.

The recent decision of the US National Institute of Standards and Technology (NIST) to base ISDN procurement requirements on ANSI standards rather than NI-1 has put some doubts on the status of the NI-1 specifications (ref. TE&M, September 15, 1992).

For basic rate interfaces, a 4 wire S/T interface and a 2 wire "U-interface" have been specified. The 2 wire loop "U-interface" using the 2B1Q transmission, with an Embedded Operations Channel (EOC) defining coding for line and terminal maintenance procedures such as loopback, performance monitoring and layer 1 activation/deactivation.

Terminal compatibility at the transmission level, has been achieved at both the S/T reference point, and at the 2 wire U-interface with NT1s. However which part of the EOC capabilities are really implemented is not defined, (e.g. activation/deactivation is not provided). Today in North America the NT1 prices, and ISDN terminal prices in general, are under downward pressure.

The specification of the 2 wire U-interface does not mean that the user "must" own NT1. Several situations currently exist:

- 1) telephone company owned U-loop, NT1 and terminal equipment (in Canada);
- 2) telephone company owned U-loop, with NT1 provided by an "arms length" subsidiary on a competitive and non-regulated basis (US situation A);
- 3) telephone company owned U-loop with CPE purchased by customer (US situation B).

In addition, the computer III decision of 1989 allows the telephone companies to handle both regulated network facilities and CPE such as NT1s.

3.3 U-interface situation in Europe

A survey on the status of the U-interface situation for most of the European countries offering ISDN has been carried out (see table), where it can be seen that a very high degree of harmonisation and de facto standardisation has already been achieved.

Apart from Belgium and Germany, the preferred line code is 2B1Q.

The NT is owned by the network operators in all considered countries and guarantees the emergency telephony service. Also all NTs can be remotely fed by the network. The feeding voltages mainly are in the range of -90 V to -99 V.

Additional information about the degree of standardisation achieved in Europe may be found in ETR 080.

Table 1: U-interface situation in Europe

Country	Line Code				NT Responsibility	Telephone Emergency Service by	Remote Power
	2B1Q	4B3T	3B2T	Biphase	Network Operator User	Network Operator	Feeding Voltage (V)
Austria	X				X	yes	(-95;-60)
Belgium		X			X	yes	-93
Denmark	X	Y			X	yes	-97
Finland	X	Y			X	yes	-97
France	X**)	Y			X	yes	(-48/+52):--100**)
Germany		X			X	yes	-97; -60
Greece	X				X	yes	
Italy	X**)	Y		Y	X	yes	-70
Netherlands	X**)	Y			X	yes	(97);-95*)
Norway	X*)	Y			X	yes	-97; -55/+55
Portugal	X*)	Y			X	yes	-97
Sweden	X**)			Y	X	yes	-70 (55/-55dc**)
Switzerland	X				X	yes	-97;-48/+48
UK	X*)		Y		X	yes	-120
Spain	X**)	Y		Y	X	yes	-97

Legend:

- *) 2B1Q starting in 1993.
- X**) 2B1Q starting in 1994.
- Y limited application.

4 Main parameters to be considered

4.1 Architecture

Figure 1, based on CCITT Recommendations I.411 and I.430 shows the existing architecture with the T reference point defined as the user-network boundary.

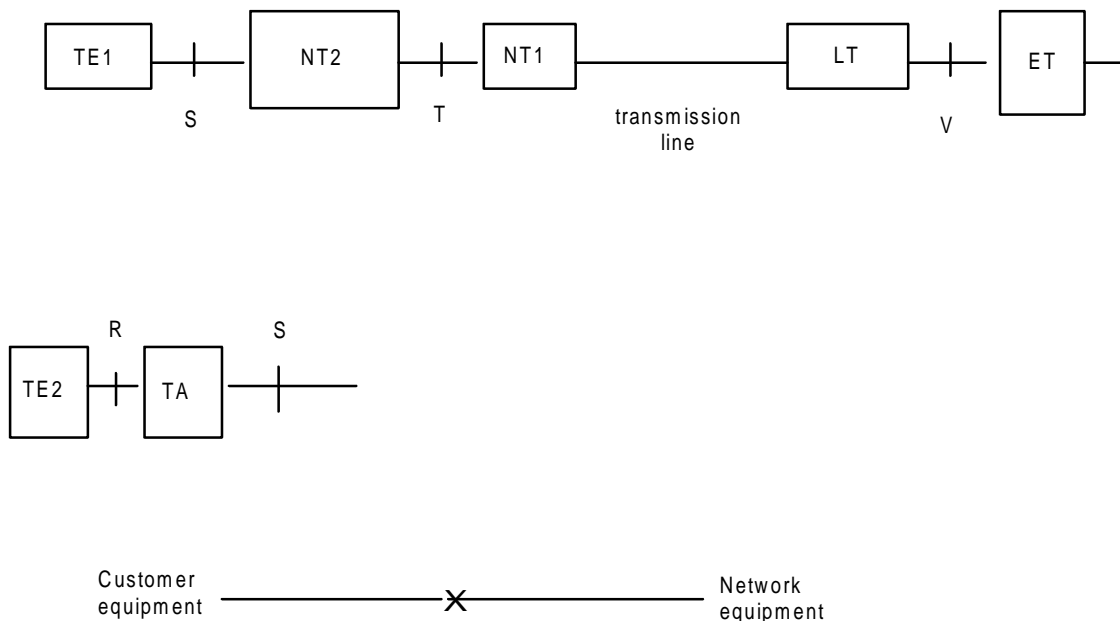
It was a CCITT objective to define "a small set of user-network interfaces that can economically support a wide range of user applications, equipment and configurations" preferably a single interface defined at each reference point to cover all configurations, e.g. single terminal and multi drop in the case of basic rate.

The physical interface defined at the S and/or T reference points in CCITT Recommendation I.430 and ETS 300 012 currently meets these technical objectives at basic rate with a single interface. In the following text, this interface is called the S interface.

Throughout the text, the term "U-interface" is used to replace the complete wording "interface at the network side of the NT1".

The EC mandate can be broken down into two separate changes to this architecture, each raising its own issues:

- a) firstly, the mandate proposes to create a standard interface at the transmission side of the NT1, commonly called the U-interface, to allow competitive procurement of the NT1 functionality. The creation of such a U-interface allows new physical configurations when no physical interfaces at the S and T reference points are required. However S and T would exist functionally within the customer owned NT1 terminal equipment. These are shown in figure 2.



TE: Terminal Equipment

NT: Network Termination

LT: Line Termination

ET: Exchange Termination

Figure 1: Existing ISDN reference configurations

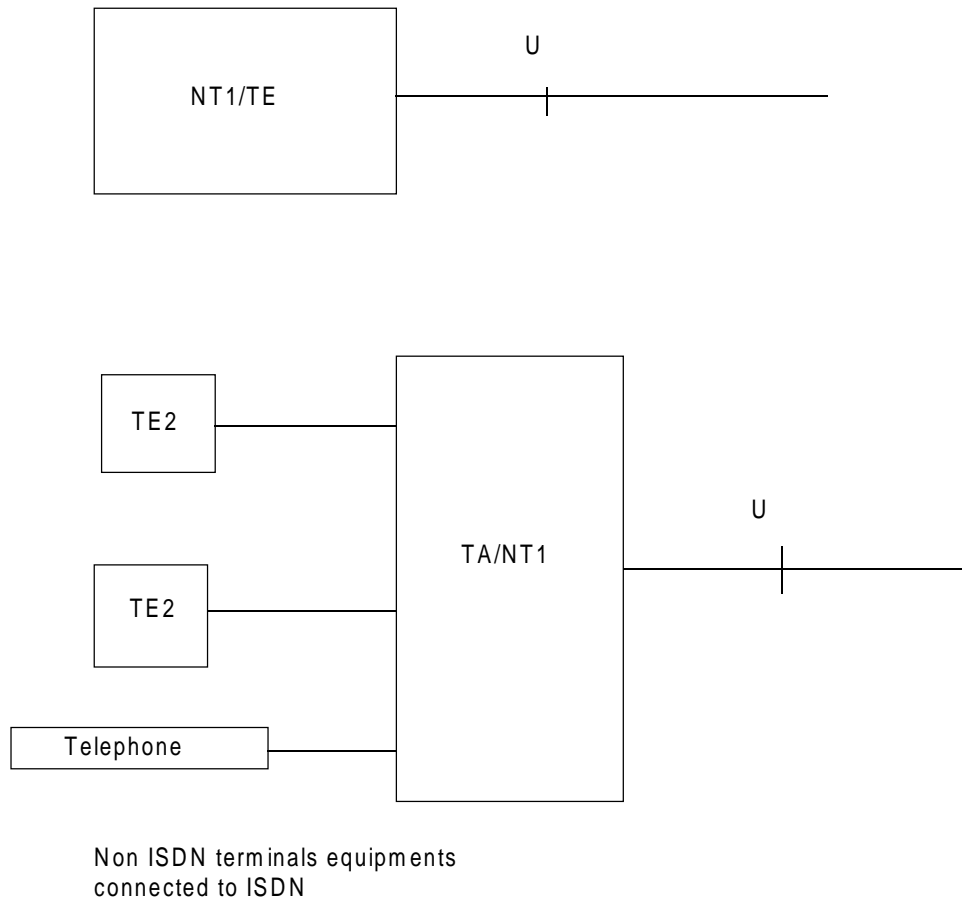


Figure 2: Terminal configurations without an interface at the T reference point

Removing the interface at the T reference point, which is redundant in these single terminal applications, should reduce the capital cost of the terminal equipment and open up new market opportunities, for example in the domestic market, where the cost of existing ISDN service with separate NT1s is considered too expensive.

The obstacle to this change is that there is no "U" reference point in the CCITT reference configuration and consequently no definition of the functionality at this point, resulting in the current range of different implementations of this interface. However, to standardise an interface at this point would require specifications at layer 1 only, in that it would be functionally identical to the T reference point at layers 2 and above.

If a standard U-interface was adopted then this interface may as well be made available at the S reference point of an NT2, such as a PABX, in order that terminal equipment designed for the U-interface could also be used on PABXs.

The need for a 2-wire interface on PABXs has already been recognised a number of proprietary 2-wire ISDN like interfaces have been implemented on PABXs in Europe. This includes the use of a 2B+D structured U-interface that would interface to a Private Network Terminator (PNT) similar to the NT1 used in the public network. There is also a Up0 interface in Germany that interfaces directly to terminal equipment where typically only 1 of the 2 B channels is used. These interfaces are in addition to the conventional 4 wire S interface (figure 3).

The use of a single 2-wire interface standard for public and private networks would help minimise the number of variants of such 2-wire interfaces that are in use.

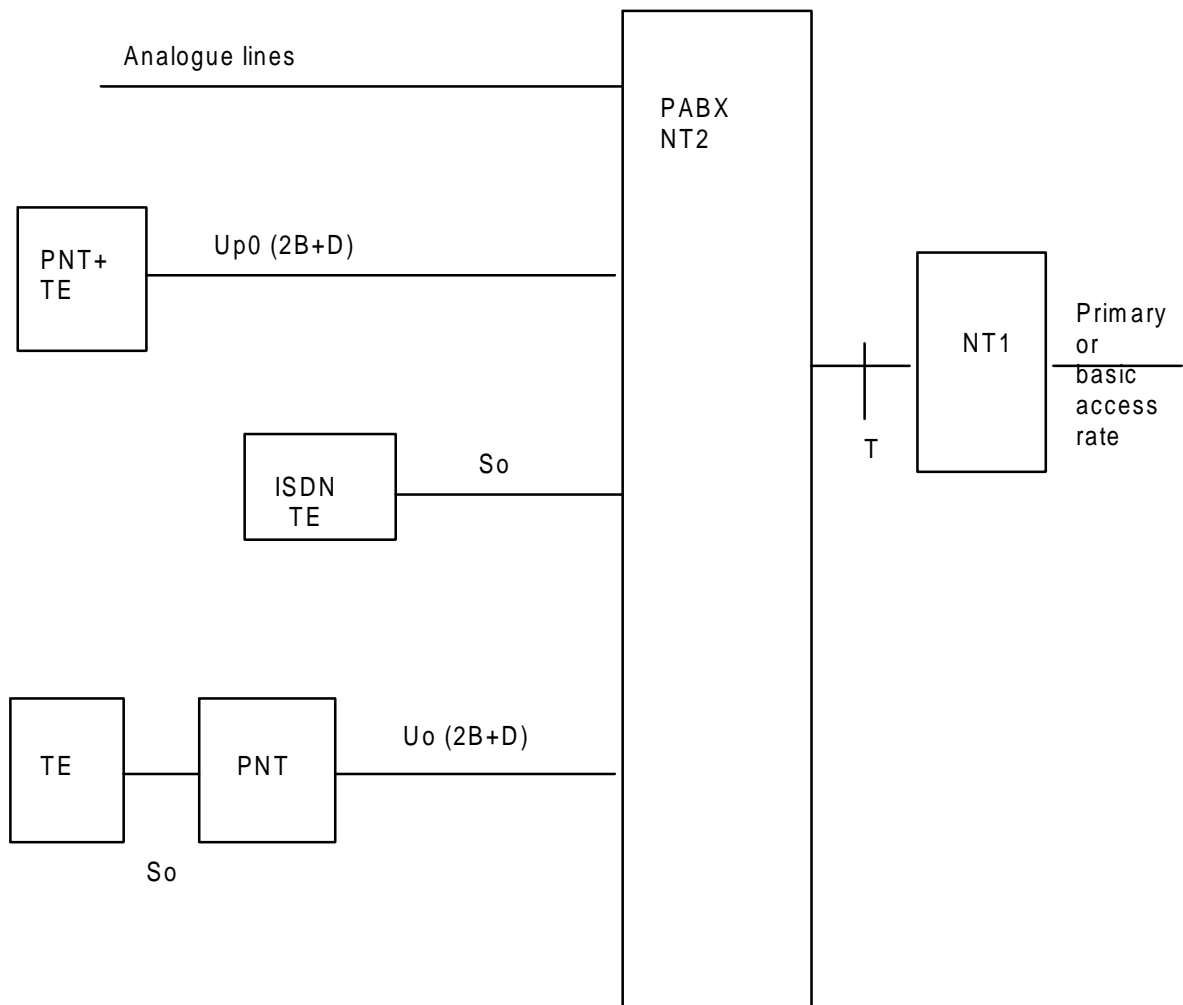


Figure 3: Some existing ISDN PABX terminal configurations in Germany

- b) the second change implied by the mandate is that the U-interface would be adopted as an alternative user-network interface alongside that at the T reference point. This allows NT1s and the terminal equipment incorporating NT1 functionality to be procured by the customer rather than the network operator.

The introduction of a U-interface would clearly imply a transmission architecture which differs to that already defined in CCITT. However, the implementation of a U architecture would not replace that already defined in CCITT but be an alternative to it. The introduction of a new alternative user to network interface defined at the U point would not, therefore, replace the existing S/T interface, but would be an alternative offering to customers who may optionally request it.

The realisation of an alternative U architecture should not change the functionality or the functional position of the S and T points although they may not be available as physical access points in the configurations shown in figure 2. In those cases where a U-interface is provided and the customer has chosen to procure a separate NT1 and separate ISDN terminal (TE1) or non ISDN terminal (TE2) then the physical arrangement of S, T and R remain unchanged.

4.2 Transmission

A good progress has been reached in defining the electrical characteristics of transmission systems in ETR 080. But if a "U-interface" is to be introduced, a detailed specification must be written, which goes beyond the content of this ETR. The work necessary in addition may be similar to that carried out for the S/T-interface specification, and it may take years until such a standard can be published, in spite of the work already fulfilled in ETR 080.

For instance, in today's installations where LT and NT1 together form one unit, the so-called access digital section, the different network operators have their special methods for monitoring the performance of the connection during normal operational conditions, taking into account the LT and NT1 functionalities. This can be done very easily, because both parts belong to the same telecommunication operator who can define the functionalities according to his needs. But if the NT1 is liberalised, and the network elements at either end of the transmission link are under different ownership, a common set of functions and conformance test procedures must be defined. The procedures already installed in the exchanges have to be changed and there will clearly be cost implications.

For a "U-interface" standard the definition of one unique transmission method must be defined, whereas today four different methods are recommended worldwide and three methods are used in Europe (see table 1). Two of them have a widespread application in Europe, namely 4B3T, which was for a long time the only solution available industrially, and 2B1Q, which is on the way to becoming adopted by the majority of network operators.

The transmission system has to cope for different network planning, installation and maintenance rules and strategies which led to a great number of national requirements, which are difficult to harmonize. In the 2B1Q transmission method for instance a very sophisticated control channel (CL) is reserved for this purpose, which allows for the variance of national options in administration and maintenance. The use of this channel must be standardised clearly if the "U-interface" is to be applied within the entire ETSI area, the problems are described in more detail in subclause 4.3. There are also service related effects to the transmission system, e.g. the partial activation which is requested from some network operators and refused strongly from others. Other functions under discussion are remote power feeding, supervision of supply voltages in the NT1, monitoring and signalling of NT1 performances conditions.

A very great disadvantage of standardising the "U-interface" is that it is only applicable for one transmission medium, i.e. for copper wires, and several standardised "U-interfaces" are needed if different transmission media are used which are candidates in ETS 300 297 subclause 4.3. This puts a heavy burden to the network operators and is considered in more detail in subclause 4.6.

For the "U-interface" a physical connector for the 2 wire copper has to be standardised which has to be protected from false connection to plugs for S/T and analogue interface connectors. For the solution of this issue ISO has to be involved. The use of other media (e.g. fibre, coax, etc.) needs to be considered as well.

For the cabling between the "U-box" and the NT1, engineering rules have to be specified because an unknown quality and length of the customer's installation cabling may decrease the range of the access of the access digital section as an effect to attenuation and impedance mismatch.

An issue mentioned here, despite it may also be taken into account as part of the maintenance, is remote power feeding,

The current situation on power feeding in European standards can be summarised as follows:

ETS 300 012 defines mandatory power feeding of restricted (emergency) power by the NT1. The allowed exception in this standard, is not a deviation from this principle, because it is relevant only to a second or further interface in parallel (i.e. restricted power feeding is not required via all of those interfaces in parallel).

In general this requirement has been defined to provide terminal portability for telephony terminals in Europe.

ETS 300 297 clarifies further, that the powering of the NT1 and the provision of restricted power is, as for the analogue access, to be provided by the local exchange. This requirement is further elaborated by ETR 080.

Nevertheless, for long lines, the use of batteries in the NT1 is allowed as an exception from this principle because the feeding voltage required may exceed the TNV limits in these cases.

Any misuse of power provided can be limited through the NT1 functionality, power limitation, conflict with normal power feeding.

In case of a U-interface and the NT1 owned by the user the control of power misuse is not possible by the local exchange. Consequences are discussed later.

The situation is totally different to the analogue access, where the power drawn has relation to the call establishment procedure and potential misuse is therefore impossible in PSTN i.e. excession of a loop current limit is taken as "off hook" by the network and if not followed by continuation with call establishment by the TE in due time, the port will be blocked and put on maintenance, which is not the case in ISDN. The power consumption of the TE in ISDN does not have any direct relation to call control procedures.

Conclusion: **Considering the transmissions aspects, it will be a possibility to achieve one or may be several-standardised "U-interfaces", but only after a time needed for standardisation which is not to be undervalued.**

The introduction will bring along a number of disadvantages for the network operators as shown above. A NT1 having to implement all the different national requirements it has to mark these options and lead to higher expenses, even if it is combined in a terminal. If the "U-interface" is introduced it shall not be the only interface to the customer, it shall be a supplement to the well defined S/T interface. This lead again to higher expenses because NT1 and terminals with different interfaces have to be provided.

4.3 Maintenance

4.3.1 General

As a general point, we have first to consider the existing situation of standardisation in Europe for the maintenance aspects of the ISDN basic rate access.

The main reference for maintenance is ETR 001 based on CCITT Recommendation I.603 outlines the application of maintenance principles to the ISDN basic rate access.

In ETR 001, functions, actions and information for operating and maintaining the part of the ISDN user basic rate access controlled by the network are described. This part of the access can be identified today as the "access digital section for the ISDN basic rate", defined in ETS 300 297, between the reference points S/T and V1.

No specific implementation of the maintenance procedure is yet defined, therefore, a unique maintenance procedure in Europe does not exist Different national implementations exist because of the different use of the same maintenance functionalities, according to the differing network operators needs (due, e.g. to different characteristics in the local loops, loops lengths, network planning evolution, maintenance strategies, etc.).

The situation is more complex if we consider that the ETS 300 297 does not define any specific digital transmission system between NT1 and LT. This is left to the network operator to decide the use of the appropriate transmission system for metallic pairs, optical fibres or radio line systems.

Therefore, specific functionalities may be introduced, in addition to those defined in ETR 001, for operation and maintenance of the chosen type of line system. These functionalities are again strictly dependent on the needs of the network operators.

Looking in particular at metallic pairs, we have today in Europe three different line transmission systems working (but only two of them inserted in ETR 080) with different maintenance functionalities. In any implementation, most of the maintenance functions and procedures are based on the presence of the NT1, which at present in Europe under the responsibility of the network operator. The NT1 is tested and approved, to national conformance requirements and cannot be removed from the network by the user.

Current ETSI studies on the line transmission system have enabled the number of future systems to be reduced to two, these are based on the 2B1Q and 4B3T line codes and described in ETR 080.

Even concentrating only on the long term candidate solution for the line transmission system, using 2B1Q line code, we can recognise a number of optional maintenance functionalities (e.g. in the "control channel" or in the "extension functions") that could be used in different way, leading to maintenance national options according to the network operator needs, giving more freedom in the planning and implementation of the most suitable access maintenance strategy.

Standardising the "U-interface", the maintenance functionalities of the line transmission system would have to be clearly defined, and valid everywhere in Europe without options in order to allow, in principle, portability of the NT1.

Whilst the TM committee has already made good progress towards harmonising the technical requirements on the line side of the NT1 (ETR 080), there is still a long way to go if total harmonisation of the line transmission system and maintenance parameters which is a prerequisite if a U-interface is to be standardised, are to be achieved.

The same work should also be done for each type of line transmission system using different physical media (fibre or radio). A very high impact on the network evolution strategy has to be taken into account, as well as the cost and delay for modifications that could be requested in the network planning already done.

In any case, the standardisation of the maintenance functionalities should not be in contrast to, but compatible with, the existing national functionalities already in use in Europe in order to reduce the modifications that would also required to the management of the digital exchanges.

It must be noted that the NT1 (in the assumption of a U-interface standardised) will be considered as a terminal from a network point of view and as such subject to agreement (permission to be connected to the network). A Common Technical Regulation (CTR) (including conformance testing specifications) will probably be needed to define the essential requirements.

4.3.2 Standardised U-interface standardised and NT1 under the network operator responsibility

Assuming that the "U-interface" is standardised, if the NT1 is approved but still under the network operator responsibility there is not much difference, at least in principle, from the existing situation, but a very difficult, and probably long, standardisation work has to be carried out with high costs and delays for the service provisioning.

Conclusion: **It will not be easy to achieve harmonisation of line transmission system and maintenance parameters in all member states and this would need to be taken account in any standardisation effort. Costs and delays for the service provisioning have to be taken into account.**

4.3.3 Standardised U-interface and NT1 under the user responsibility

If the U-interface is standardised and the NT1 is under the customer responsibility, a new boundary point, between the user and the network, has to be defined. It is provisionally understood that a "U box" is necessary to form a new network termination. This box could include some maintenance check capabilities, overvoltage protection devices and a socket for the NT1 connection (see subclause 4.5).

Other points have been identified and should be clarified (besides the standardisation work already identified in subclause 4.3.2):

- 1) who will be responsible when a fault is eventually reported, by the user, as a line fault but then localised, by the network operator, as between the NT1 and the "U" socket?

An administrative solution can be elaborated stating that if the user reports a fault which is then localised in his portion of the access, he may be charged for the real cost of the network operator intervention. This clause may be included in the contract but could modify the maintenance policy (e.g. number of people in charge of maintenance).

A technical solution could complement the previous one allowing the user to test his part of the access, between the NT1 and the "U" socket. In this case appropriate functionalities have to be foreseen inside the NT1 and the "U" socket or box;

Conclusion: **An administrative and a technical solution are identified. The administrative solution may be included in the contract. The technical one requires appropriate functionalities inside the NT1 and the "U box" defined internationally.**

- 2) existing CCITT Recommendation I.603 and ETR 001 mention that it must be possible to check the access even if some problems occur inside the in-house installation. This is required to communicate appropriately with a calling user in case of call delivery problems at the called user side. In the case where the NT1 is under the user responsibility and is removed from the network it could not be possible to perform those maintenance actions controlled by the network and based on the presence of the NT1 (e.g. transmission performance monitoring, measure of the line parameters and loopback 2).

Associated with this discussion of the "U-interface", discussion about the guarantee of transmission performance levels for ISDN are taking place. These two aspects are in conflict with each other and digital performance guarantees cannot be given from the network operator if the NT1 is in the user's responsibility.

A possibility for resolving the question has been identified implementing a device, controlled by the exchange (by the line feed voltage for example), inside the "U" box where also the "U" socket may be placed. This would in principle enable the operator to perform analogue line test capabilities between the exchange and U Box with a performance capability similar to that being achieved on today's analogue loops connected to digital exchanges. However, if a fault appears between the NT1 and the "U" box no indication can be provided to the network. The inclusion of the active components in the device must be carefully investigated because of the possible impact on the customer loop characteristics, transmission performance and power feeding (power feeding requirements may also be complicated and need to be quantified).

Conclusion: **Digital transmission performance guarantees cannot be given by the network operator and loopback 2 cannot be operated if the NT1 is removed from the network. Analogue line test can be performed between the exchange and U box, but this capability will be dependent on the technical complexity of the circuitry inside the U box as well as on the customer loop characteristics. The cost of introducing a U box with loopback capability will need to need investigated.**

3) loopback 2 interpretation and continuity test.

If the NT1 no longer belongs to the network, the interpretation of loopback 2 (described in CCITT Recommendation I.603 and in ETR 001) has to be revised. In fact, today when loopback 2 is established, all the part of the basic access under the responsibility of the network is considered to be correctly functioning, while if loopback 2 fails it is clear that the failure is inside the network. Loopback 2 can still be implemented from the exchange to the customer owned NT1, or terminal with an NT1 combined, and under non-fault conditions would enable the digital performance of the loop to be checked out to the same level of quality as that achieved if the NT1 were in the public domain. However, if a problem occurs somewhere on the line it may not be possible for the operator to determine whether the fault lies on the customer side of the U box or the network side of the U box. The only available check the operator could implement under these conditions, would be the analogue tests between the U box and the exchange as indicated in 2), above. If the customer is to be offered the capability of testing the section between his own NT1 and the operator's U box, then additional functionality would need to be added to the U Box and the NT1 functions. The complexity of this functionality would need to be determined as well as its impact on exchange test procedures.

The continuity test defined in ETR 001 cannot be performed if the NT1 is removed intentionally from the network by the user. Also in this case, additional functions and procedures need to be defined.

Conclusion: Loopback 2 can still be operated but it will not permit to distinguish if a fault is in the user part or in the network part of the access. Additional maintenance functions need to be implemented in the U box.

Technical solutions can be adopted in the U box (that may be considered the new boundary between the user and the network) to solve the above points. But like this the U box looks as an NT1 or a simplified NT1 and additional complexity and costs have to be taken into account when considering the introduction of such a new interface.

The introduction of these new analogue line test requirements between the exchange and U box have never been previously considered in the ISDN test specification and are likely to raise new complexities thus adding to the overall costs of service provisioning. The analogue line tests between the exchange and U box are clearly quite different to what has been already specified for the ISDN access digital section which includes the concept of synchronisation and master-slave relationship.

ISDN service is supporting detailed cause information to the calling user why a call cannot be delivered to the called user. Without the NT1 under the network operator's responsibility this information is not available from the normal procedures defined for the access digital section and can only be obtained after additional line testing, which increases cost, adds delay handling and affects the defined ISDN services.

4) what about remote power feeding if the NT1 is not in the network operator possession?

This aspect is not only a maintenance matter and is more general question for the provisioning of the service. Provision of restricted power feeding is defined as a mandatory requirement for all European countries in ETS 300 012. To be able to provide this capability remote power feeding from the exchange battery is necessary, but if the NT1 is in the possession of the customer, the power can easily be misused for purposes other than feeding the NT1 and an emergency telephone, and no control mechanisms are possible in the exchange. For this reason at least, some network operators will not provide remote power from the exchange, or will be obliged to do so following intervention from mains supply companies, so that emergency telephony service will not be supported in their network;

Conclusion: As emergency telephone service is considered mandatory in PSTN, it shall be considered in the same way for ISDN. When the NT1 is owned by the user, misuse of the remote power cannot be prevented and violation of other regulations may occur.

5) measurement instrumentation of the transmission quality.

Most of the instrumentation currently available today to measure the transmission quality of the access is connected at the S/T reference point by plugging the tool into a socket along the S/T bus. Shifting the limit of responsibility from T to U, leads to implement new measurement instrumentation to be connected at the U boundary point and some questions arise:

- how to connect the tool at the line?
- how to guarantee the quality of transmission at the S/T reference point when the NT1 is under the user responsibility? (In this case the quality of transmission at S/T reference point could be different from the quality of transmission measured at "U" boundary by the network operator).

Conclusion: new instrumentation to measure the quality of transmission at the U boundary has to be implemented. Procedures on how to connect the tool to the measurement point when the NT1 is in service, have to be identified.

6) line test equipment.

The present situation is based on CCITT Recommendation I.603 "Application of maintenance principles to ISDN basic access".

The various equipments and mechanisms implemented to maintain the line are illustrated in figure 4.

The ET supervises failure detection and failure localisation.

Failure detection takes into account the following information:

- loss of frame alignment at U and at T reference points;
- activation failure;
- supervision of power feeding at U and at T reference points;
- transmission performance monitoring (i.e. CRC check procedure and transmission performance evaluation).

Failure localisation uses automatic mechanisms based on loopbacks implementation (Lb 1, Lb 1A, and Lb 2), and a line parameters measurement facility, to provide the electrical parameters of the line for a more precise failure localisation.

In the case where the NT1 and the TE are combined, the solution is illustrated in figure 4.

The need for a U box at the customer premises is identified.

The box belongs to the network operator and gives the possibility to carry out analogue tests of the line ("AtX" in figure 4). It is understood that the "AtX" is not operated on the B and D channels but is rather an AC or DC measure to check if the U is present or not on the line.

This "AtX" is not defined in the existing recommendations or standards for maintenance of the ISDN basic access.

To test the network side, the ET has to carry out Lb 1, Lb 1A, "AtX" plus connection of the line to the robot in charge of measuring the electrical parameters of the line.

NOTE 1: Usually there is one robot for several hundreds of LT. Only one line can be connected to the robot at the same time and the duration of the test can be greater than 10 seconds. These considerations raise the question of the availability of the test equipment. The activation of "AtX" must not increase the typical time requested for the measurement of the line parameters.

NOTE 2: The charge of the network maintenance will be depending on the operation and maintenance of TE/NT1.

The maintenance of the NT1 is under the user's responsibility. This means that loopback C is requested (according to CCITT Recommendation I.602).

Currently, this loopback is not included in the section specification (CCITT Recommendation G.960 or ETS 300 297) and not implemented in the existing components. Moreover, for the operation of loopback C, attention shall be drawn to the NT1 synchronisation concept and master-slave relation.

The wiring between the TE/NT1 is also under the user responsibility.

Conclusion: If TE and NT1 are combined the need for a "AtX" inside the U box is envisaged. This "AtX" is not defined in CCITT Recommendation I.603 and ETR 001. Also loopback C may be necessary for user's maintenance procedures. Compatibility with the existing maintenance procedures and synchronisation concept has to be taken into account.

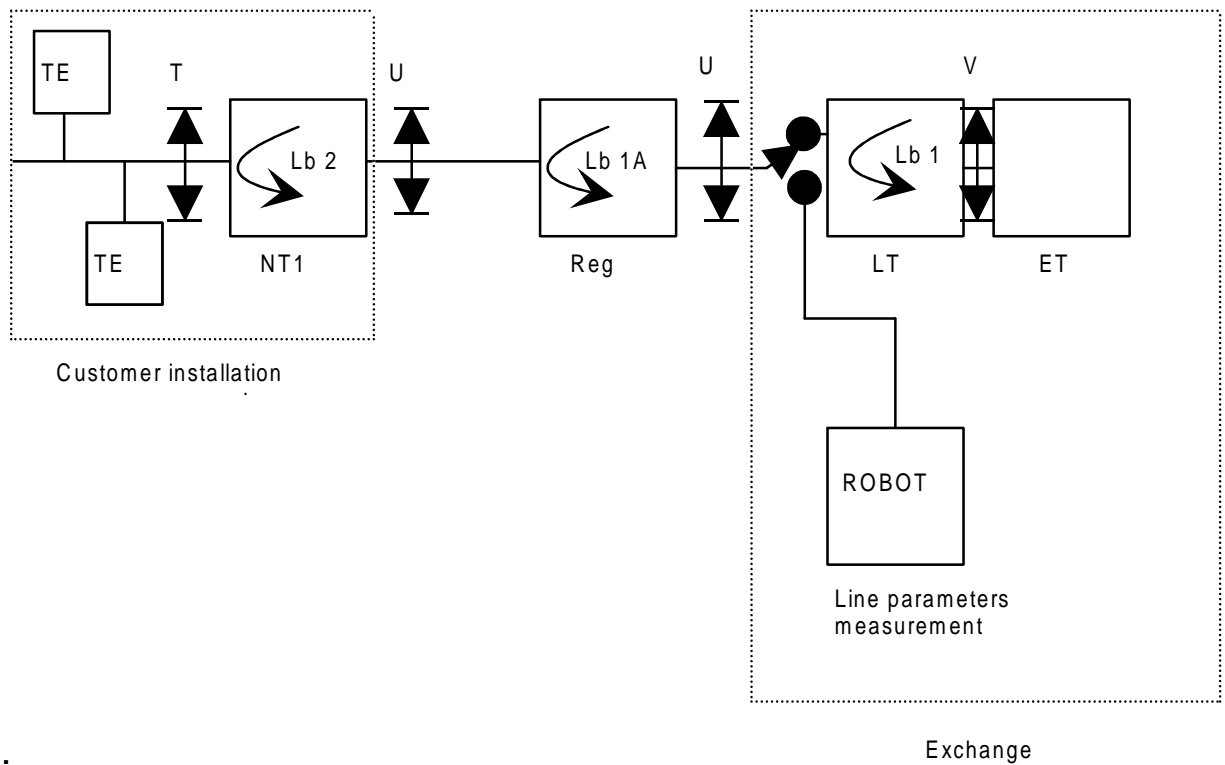
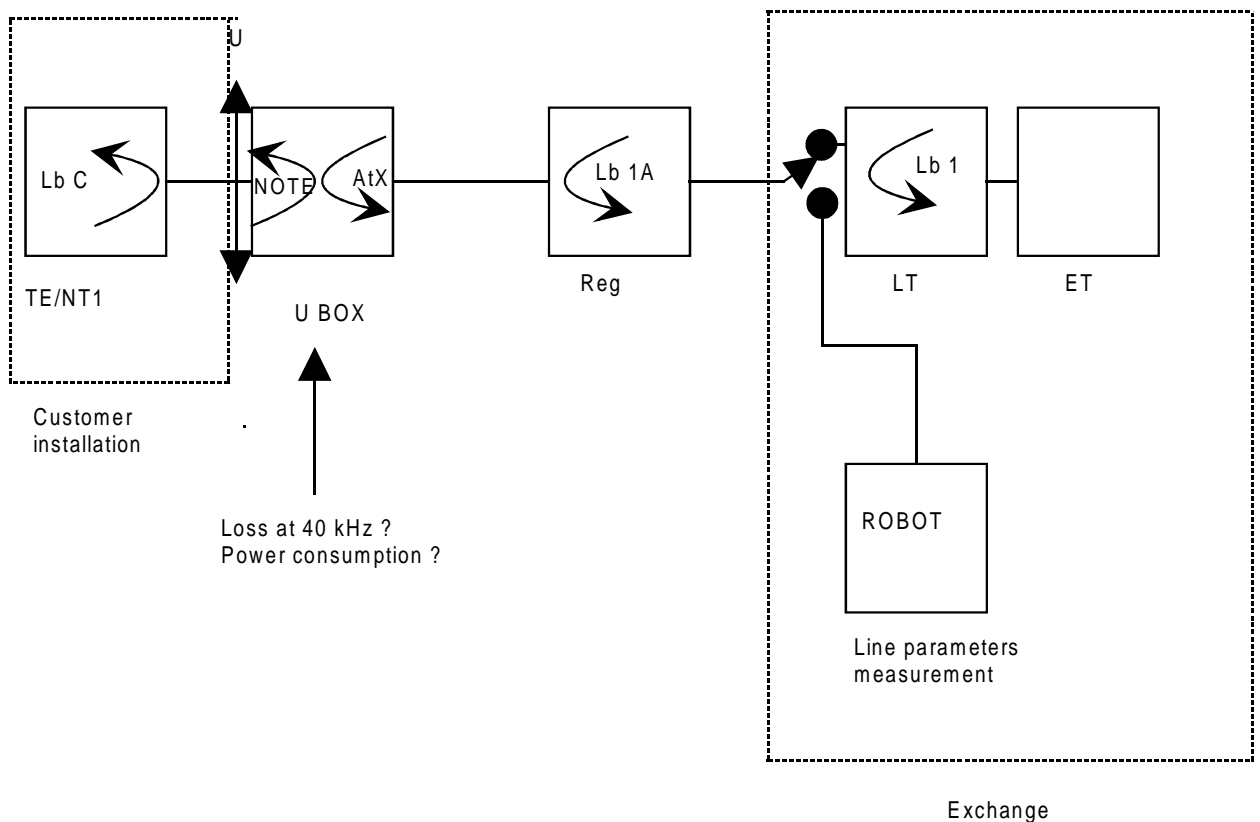


Figure 4a: Line test equipment existing today



NOTE: Test capability in the NT1 with the respond capability in the U box.

Figure 4b: Line test equipment for user-network boundary at U-interface or/and combined NT1/TE

4.4 Safety and protection

From the viewpoint of safety and protection the U-interface for ISDN basic access is very similar to the analogue interface including fax machines. The only, but important, difference is that in some countries the voltage used for remote feeding is substantially higher for ISDN than the analogue lines and may come near to the TNV limit. The adoption of the U-interface as the user-network interface may require changes to the guidelines covering rewiring within the customers premises, and possibly changes to associated regulations. In many circumstances customers currently undertake rewiring without taking any safety precautions, but the doubling of the DC voltage through the use of the U-interface may be considered to make this practice unsafe.

4.4.1 Protection against TNV voltage

According to IEC 950, section 6.2.2, the contacts in a socket similar to that of the ISO 8877 connector as used for the S/T interface are not touchable with the test probe defined. This connector is, therefore, safe for TNV voltages composed of a DC and an AC part not exceeding the limit defined by the formula:

$$\frac{U_{ac}}{707} + \frac{U_{dc}}{120} < 1$$

This limit is not reached by the supply voltages specified by the network operators under normal conditions.

However, problems may exist in countries using high DC supply voltages, i.e. - 97 V, if high longitudinal voltages are induced permanently by trains for which values up to 50 V have been measured, producing a total voltage which exceeds the TNV limit.

Also, in the analogue telephone network, the voltage of the calling tone leads to a total voltage exceeding the TNV, which is tolerated silently by the TOs and IEC. But in this case the DC part is low and the calling voltage is interrupted by long pauses which reduces the danger, while ISDN has a high DC part reaching nearly the limit, and a permanent AC part.

Some TOs say that they can accept this high voltage in ISDN if only skilled personnel can come into contact with it, but that they are not willing, for reasons, of responsibility to provide a high DC supply voltage if the customer is responsible for the NT1 and can be endangered by voltages beyond the TNV limit.

In this case the full range of subscriber loops or the emergency service cannot be provided.

4.4.2 Protection against mains voltages

No difference exists compared to fax-machines connected to the analogue network. The conformance to EN 60950 and EN 41003 has to be achieved before getting the acceptance from the network operator as usual.

4.4.3 Requirements for EMC

First investigations proved that the requirements will not be different to the existing. But the investigation does not cover all countries and additional comments are requested.

Conclusion: From the viewpoint of safety and protection under normal conditions most of the requirements are covered by the existing permission of equipment for analogue interfaces. But if induced voltages with high levels have to be taken into account it may not be possible to provide the full ISDN service due to safety requirements.

4.5 Implementation of the U box

If the U-interface is adopted as an alternative user-network interface there are a number of reasons why it may still be necessary or convenient to have a network terminator entity, or U box, on the network side of this interface. The U box, however, is likely to be considerably simpler and cheaper than the existing NT1 function.

Testing

The U box could contain circuitry to provide the network operator a limited capability to test the network up to the U-interface now that loopback 2 within the NT1 cannot be used to determine whether a fault lies in the network or the customer equipment.

Such a circuit would disconnect the customer equipment from the line in response to predetermined control signals from the network such that the network can be isolated from fault conditions in the customer equipment. It would then present a defined impedance to line allowing a range of analogue line tests to be performed.

The following of this subclause is not completely agreed, as it describes only an example of solutions for some U box functionalities requirements. The full set of U box requirements need, however, to be considered further.

Such a circuit could respond to the DC potential on the U-interface with the assumption that power feeding is available over this interface. During normal operation, it would present a high impedance to the line, but when the line voltage at the U-interface was reduced to an intermediate range, for example 10 V to 28 V, the NT1 would be electrically disconnected from the line by the U box such that the only termination of the line is then provided by the test circuit. This may require new functionality within the exchange line test circuit.

A prototype design using this principle indicates that a power consumption in this mode of 10 mW with a line voltage of 50 V at the U point and 60 mW with a line voltage of 100 V should be achievable. It should introduce negligible additional attenuation of the ISDN line signals in that the only additional series elements are 2 relay contacts. In principle, there should be no problems with operating in the presence of regenerators, providing the regenerator function is constrained to present a high DC and AC impedance when the line voltage drops below a certain value. This parameter, although specified for the NT1 in ETR 080, is currently unspecified for the regenerator function.

One restriction of the proposal is that in the event of a short circuit on the line it would be unable to differentiate between a short-circuit on the user side and the network side of the U-interface. In addition, the U box, whilst allowing basic analogue measurements to be made, would not allow measurements of network transit delay and bit error ratio. Such measurements were specified in the CEC Council Recommendation of 5 June 1992. Furthermore, although simple in design the "U box" will still entail some additional cost which has to be taken into account.

Protection

It is probable that primary protection to prevent the propagation of hazardous voltages through to customers equipment will be required at the U box.

4.6 Network evolution strategies

The local loop has, in the different countries in Europe, different configurations which may also vary from one country to another country but may vary inside one country depending of different considerations, such as big cities, small cities, mountain areas, etc. Depending of the situation different transmission media should be used, metallic pair cables (several types with different electrical characteristics may also be used), fibre optic (some operators have decided to replace old metallic cables by fibre optic, even for the POTS), radio systems.

The technology to be used for customer lines is also very much related to the number of lines to be established on the same path towards a common zone.

The existing situation is a fact which cannot be modified in a very short period of time, if modifications have already been planned, any modification to the planning represents either modification of the investment planning or additional delays for the improvement of the network and as a consequence in the improvement either of the quality of service or of service provision.

Several non-technical parameters intervene in the planning, as the telecommunication media often cross the public domain, coordination between several public entities is required, (road, water supply, etc.) and any change in the telecommunication planning may also impose modification of other planning, the consequences in terms of money may be very heavy if, for example, the road work needs to be done twice, in addition, the budget, the manpower available at a given time are very seriously considered and this implies that such a planning is normally 5 years planning.

A U-interface in principle does not constrain the operator from implementing new loop technology on the line side of a U box but the operator would need to ensure that an equivalent U-interface is made available to the customer with whatever technology is used to replace copper.

In the case of copper fed customer installations with operator owned NT1s, an upgrade to fibre would mean that the new operator supplied line equipment (e.g. optical NTU) would be required to deliver an equivalent interface to the line side of the customers existing NT1. Alternatively the optical NTU may be designed to include the NT1 functionality itself, in which case it would provide directly an S point to the customer, thereby removing the need for the already installed operator supplied NT1.

In the case of a copper fed installations with liberalised NT1s, that is with an existing U-interface, an upgrade to fibre would mean that the new operator supplied optical NTU would need to deliver a U-interface to the customer's U box.

Contracts between customer and telecommunication operator who provide a U-interface should include clauses to cover changes over a reasonable period of time.

The evolution of the technology is now such that the tendency is to go to fibre optic in the local loop, for broadband services or even for the POTS, this evolution is now well taken into account and the definition of a pure copper interface which will consider only one part of the existing situation and will not take into account this evolution may lead to difficult situations. In general, terminal technology will evolve as the networks themselves evolve and in the future new interfaces will start to emerge. For instance in the future there may be optical feeds directly to customers premises and this may entail provision of a broadband interface in addition to narrowband interfaces, for which there will emerge compatible broadband terminals.

With the existing situation, (see figure 5) the network operators can provide technological advances in a smooth manner by replacing a complete transmission system, when and where it is really appropriate. It must also be considered in the evaluation that the allocation of functions, if U exists, between the user side and the network side will be fixed for at least the life time of the user equipment and that this allocation of functions will probably rapidly become obsolete, depending on technological and market changes. If new functions need to be developed or implemented, common agreements between the user and the network operator will need to be sought, this will probably lead to different versions inside the network or delays in development and implementation. If several versions exist, several specifications will need to be provided and a management problem will need to be solved.

Functions which need to be provided on a regulatory basis need to be defined, as well as functions which may be provided on a competitive basis (e.g. remote power feeding) as this function allocation and evolution is also a key point in the network evolution strategies.

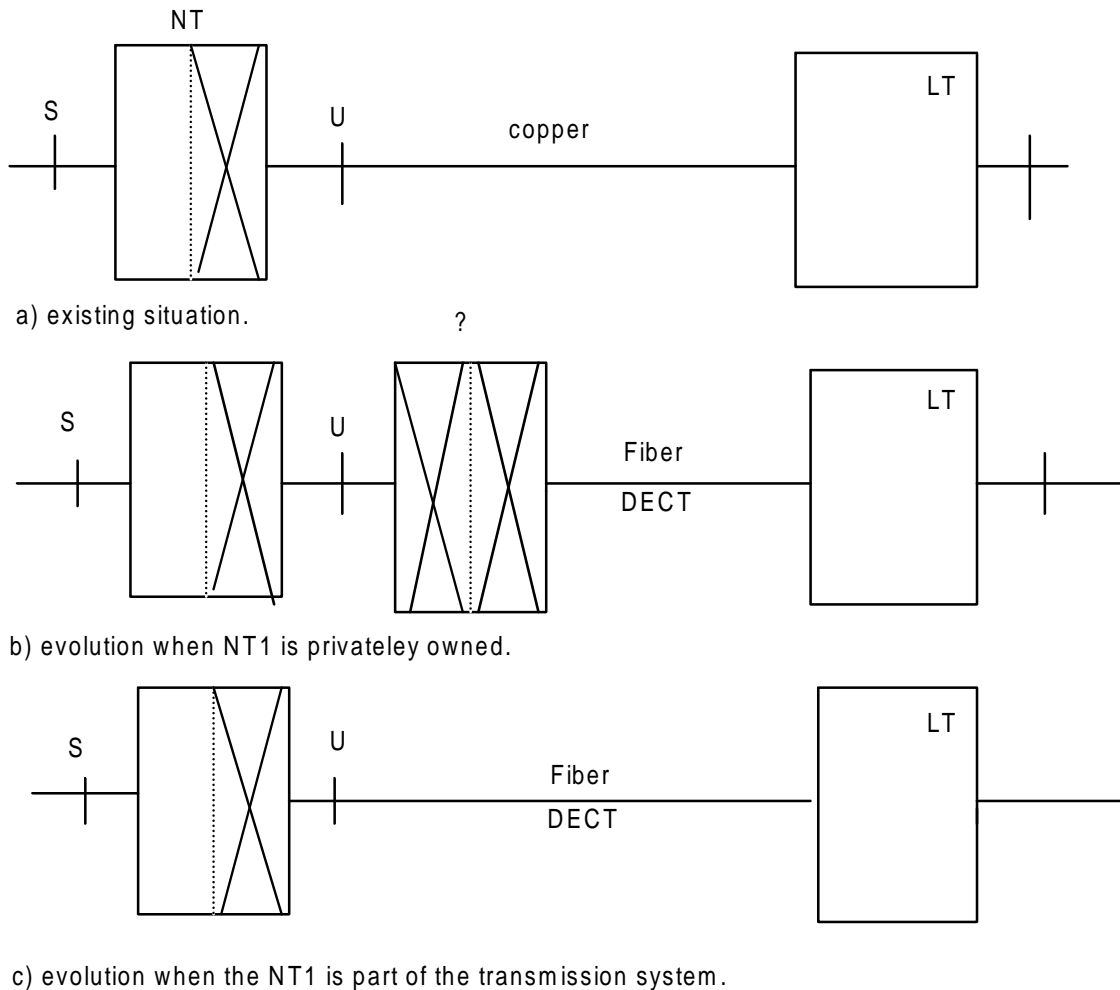


Figure 5: Evolution strategies

4.7 Marketing an ISDN basic access that has two user-network interfaces

The selling of ISDN to customers is already difficult because it is not a product but a service access method (bearer service). The addition of an alternative ISDN user-network interface will enable customers to obtain NT1, or combined NT1/terminals as customer equipment. This should allow the competitive pressures in the market place to drive down the price of the terminal equipment, especially simple mass-market equipment that does not require the use of an interface at the T reference point. However, this could raise a number of issues if the customer wishes to migrate from one interface to another.

To enable the customer to be able to obtain compatible terminals (e.g. telephones, fax machines, PC cards) it will be necessary for the customer to know if they are connecting to a S interface or a U-interface, as U and S interfacing terminals will not be compatible. Alternatively, a terminal may have both S and U-interfaces, but this has cost implication.

If the customer has an initial requirement that could be served by a U-interface, and then at some later date wishes to develop the installation by adding additional terminals, it will be necessary to convert from a U-interface to a S interface. This would involve abandoning of the U terminals and replacing them with a NT1 and new terminals. The opposite scenario would be to remove the unwanted terminals from the S-bus.

In the case of the U-interface terminals, the customer would only be able to have two B-channel calls in progress, providing it is a multi-service terminal (i.e. telephone/fax).

In the case of the S interface terminals, the customer may have a number of terminals and will be able to have two B-channel calls in progress providing there is more than one terminal connected to the S-bus. These terminals can be of the single service type.

In the case of Packet Mode Bearer Service (PMBS) through the D-channel, there is the capability of having several packet calls in progress in parallel to the B-channel calls.

Perhaps the most significant problem to the take-up of ISDN services is the proliferation of interfaces causing dilution of the market share for terminals. This will result in increased management costs and cause customer confusion.

The customer is not interested in interfaces, only in services and their perceived cost and benefits. If customers are made aware of the differences between the S and U-interface services it may be considered that the PTOs are trying to minimise costs by passing them on to the customer.

5 Standards to be developed or modified

- 1) Layer 1 specification for the 2 wire user-network interface.

A new Standard would be required covering the layer 1 specifications for the 2-wire user network interface. This would be an "alternative" to the current ETS 300 012. A significant proportion of the contents of the new specification should be capable of being taken from:

- G.960/ETS 300 297 Access digital section for ISDN basic rate;
- G.961/ETR 080 Digital Transmission System for ISDN basic rate Access;
- ANSI T1.601 ISDN Basic Rate Access on the network side of the NT1.

There would be no equivalent CCITT Recommendation to this ETS.

- 2) Definition of a standard for the U box.
- 3) A CTR for the NT1 to be defined.
- 4) The U plug and socket to be standardised.
- 5) The cabling between the NT1 and the U box to be approved.
- 6) Maintenance.
- 7) NET 3: attachment requirements for terminal equipment to connect to ISDN using ISDN basic access, layer 1.

A new section of NET 3 would have to be introduced specifying the alternative layer 1 standard, together with the associated conformance test schedule.

- 8) ISDN reference model.

At present there is no ETSI document covering the ISDN reference model. The proposed architectural changes would bring the European reference model out of line with that in CCITT requiring an ETSI document to describe these changes.

6 Useful information to help making economic evaluation

6.1 General

This Clause does not intend to be a complete economical evaluation and only provides information which may be used for additional work on this matter. These calculations follow the OVUM assumption in terms of cost calculation (cost reduction percentages), however, this information must be read with the understanding that such an approach, only based on a comparison between a purely customer related cost with a combination of customer and network inherent costs, could be misleading. In addition, impact on tariffs were not considered and the group felt that it would be needed to distinguish between network costs covered by tariffs and customer equipments cost.

6.2 General assumptions

Three cases have been considered after discussion with the EC representatives:

- terminal equipment TE1 with U-interface, integrated NT1, and S-bus functionality;
- terminal equipment TE1 with U-interface, no NT1 functionality and no S bus functionality (i.e. single terminal application);
- terminal adaptor with U-interface and integrated NT1.

To be able to compare the three identified cases, they are first described below where U does not exist, (existing international recognised cases), and then with U available. The calculation is based on current real figures for each piece of equipment.

6.3 International description

The three cases given in subclause 6.2 are described according to the ETSI or CCITT approach, where no U is defined, either as an interface or as a reference point (see figures 6 to 8). It should be noted that the main application which is considered is the most common (i.e. the telephone) for figures 5 and 6. For figure 7 the complexity resides in the number of analogue interfaces connected (so-called R) and their complexity (CCITT V or X series of Recommendations).

The different blocks used are also commonly approved as a good basis for the description of the terminal functionalities.

According to the existing international description, the NT1 is a separate entity pertaining to the network, the opening is currently considered at the T reference point and the terminals are plugged into a standardised socket to access the S-bus.

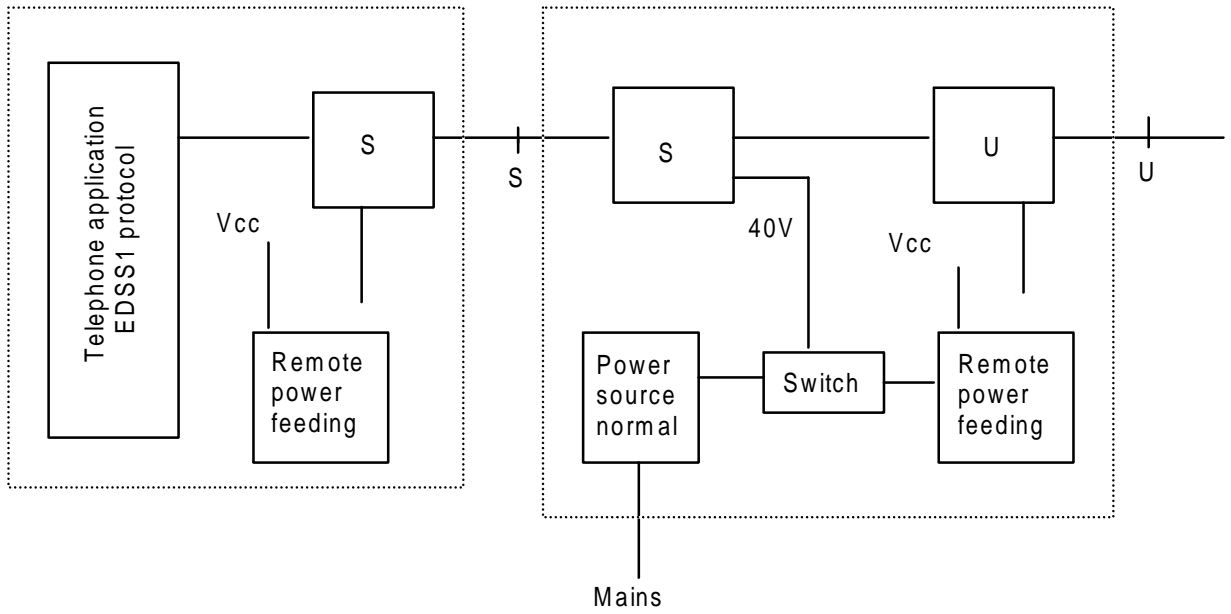


Figure 6: NT1 with separate standard ISDN telephone and S-bus

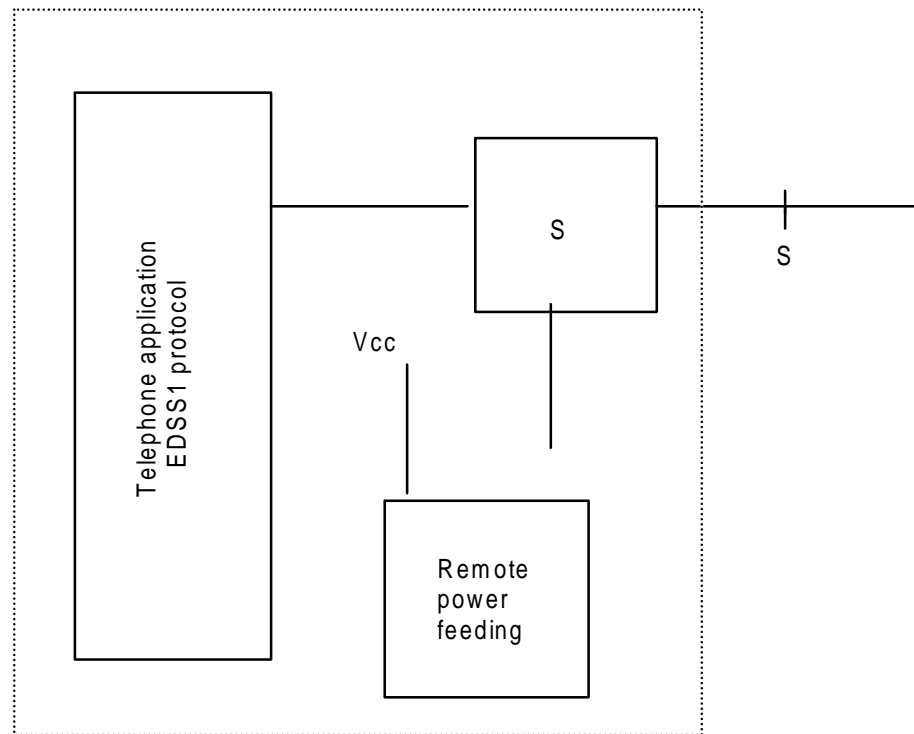


Figure 7: Standard ISDN telephone terminal functions

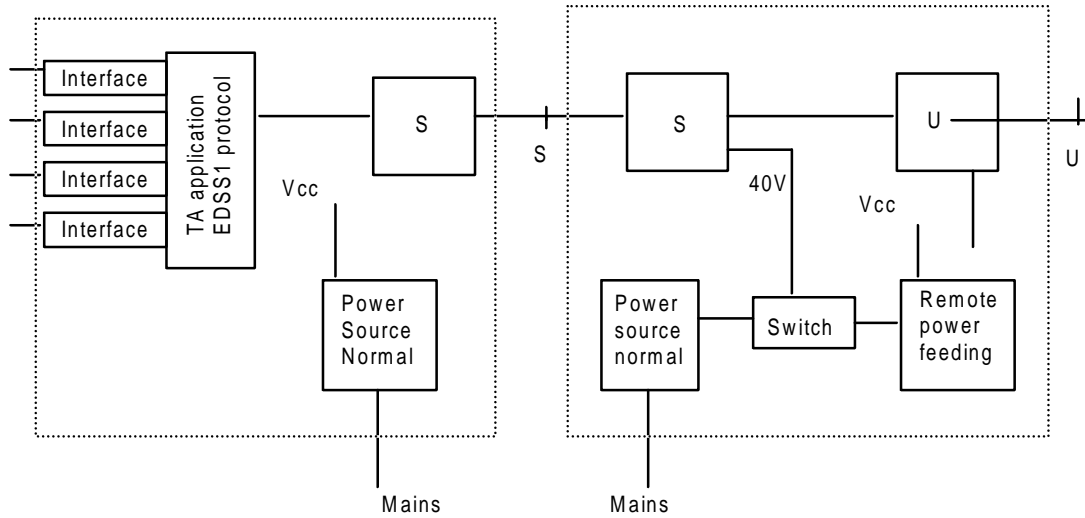


Figure 8: NT1 with separate terminal adaptor and S-bus

6.4 Introduction of the U-interface

The same three cases have been considered and described according to the U-interface being introduced, see figures 9 to 11, with the same hypothesis as above as far as the services are concerned. It is worth noting that the second case in figure 10 is considered as a pure theoretical case, as a telephone cannot make use of the full capability of the line (2 x 64 kbit/s plus D) so the terminal in this case cannot be a simple terminal (even single), and the one identified so far is the videotelephone where the NT1 functionality does not constitute the major cost.

In addition the same problem occurs for the terminal adaptor for which the number of terminals, the kind of terminals and the type of interfaces connected need to be defined.

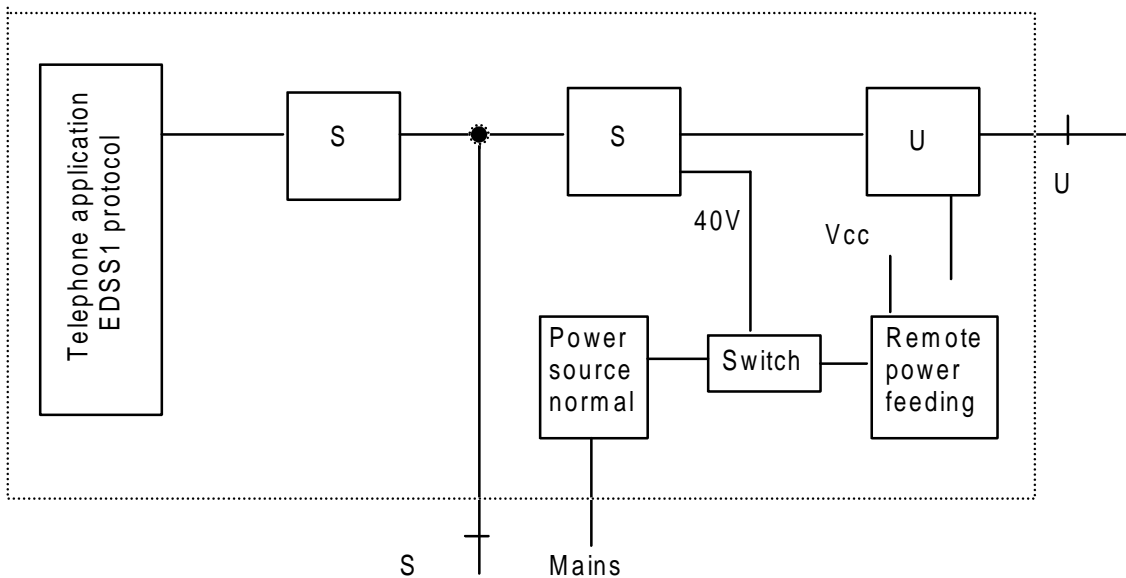


Figure 9: Telephone with U-interface and providing S-bus

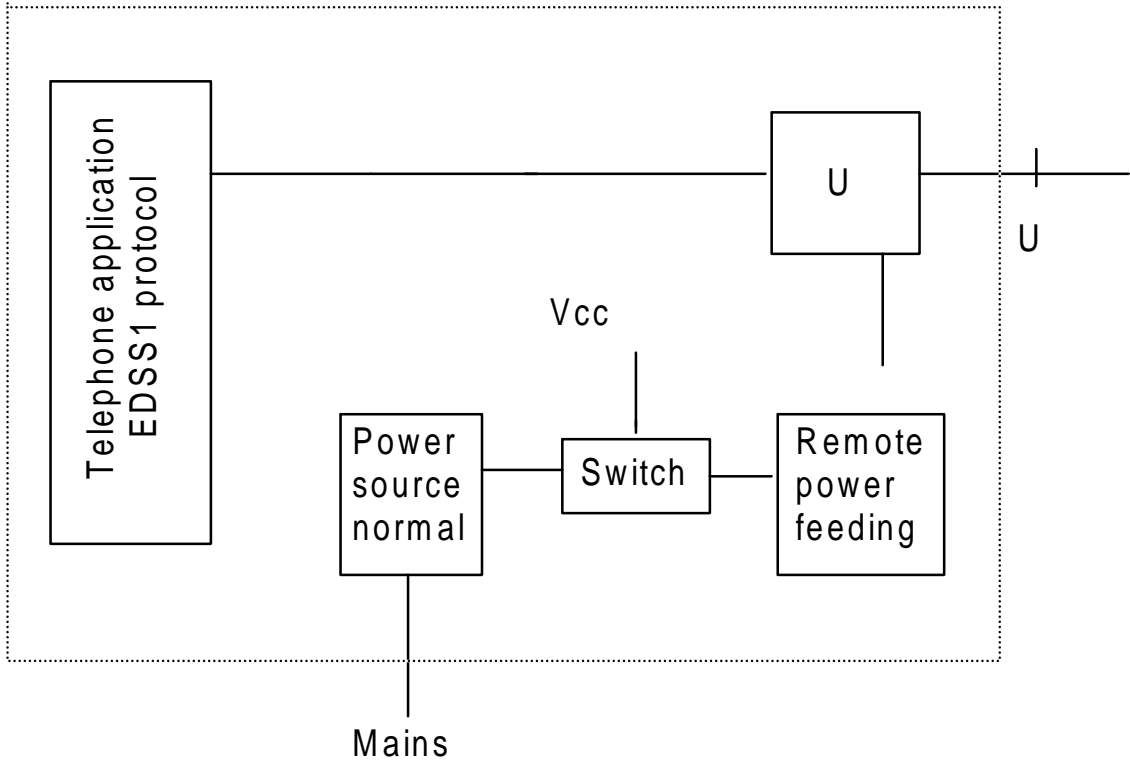


Figure 10: Single telephone with U-interface

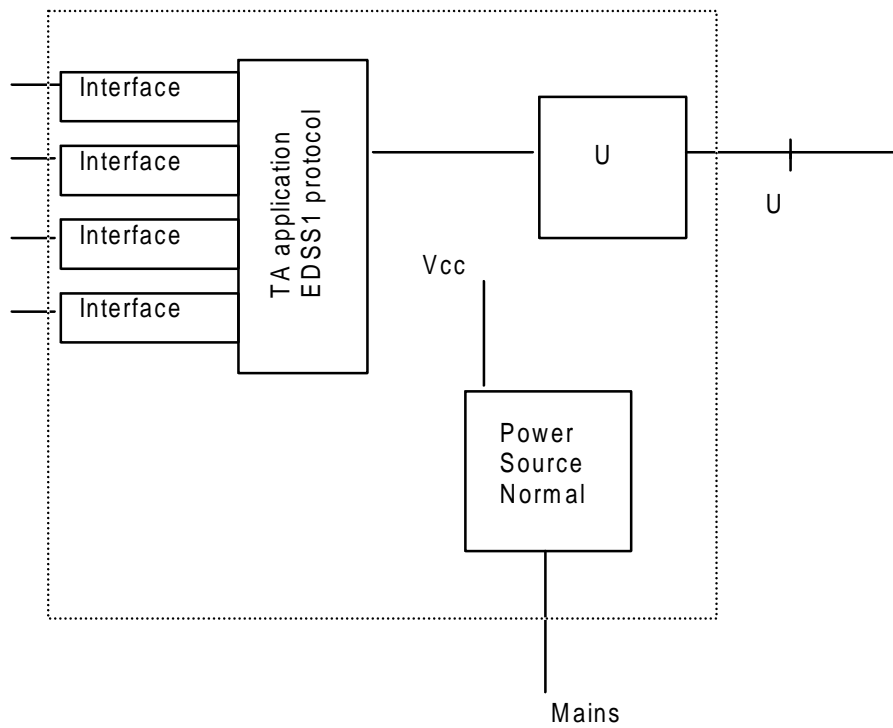


Figure 11: Terminal adaptor with U-interface

Another possibility was also considered, proposed by OVUM (see figure 11) this configuration is based on the fact that the first terminal in the in-house installation is a telephone terminal, the user has full choice for making the evolution of the terminal. Three modules are defined the basic terminal on the left hand side, the U module which is plugged in the terminal module if the user wants only a single terminal, the S-bus module which is indicated on the right hand side which replaces the U module when the user wants several terminals to be connected to the S bus.

However, it should be noted that:

- this terminal is dedicated to access the transmission line;
- this terminal is the weak point of the installation, if it is broken and needs repair, the in-house installation will be out of order (as the NT1, but the later, being fixed to the wall, is less sensitive to physical damage).
- this terminal needs three cords, one for the mains, one for the S-bus connection provided with an ISDN plug and one for the U side provided with a specific plug not yet defined;
- the user is tied to a specific manufacturer as the interface between the terminal module and the other modules is not standardised;
- when moving from the single terminal solution to the S-bus solution, the user is the owner of a U module which is no longer of use, in other words, the user has paid for a module which cannot be reused.

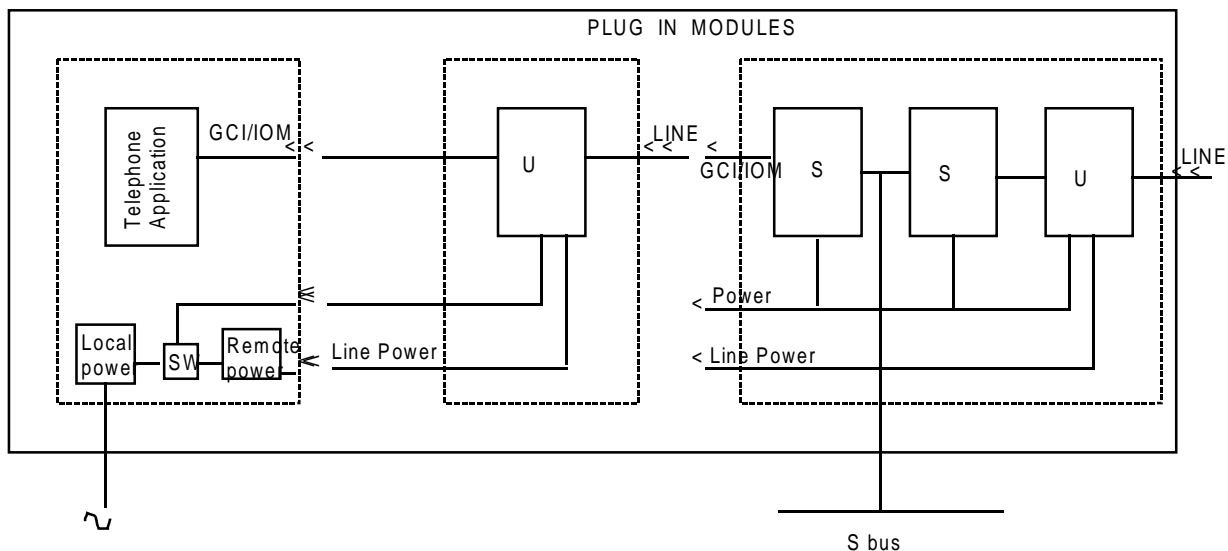


Figure 12: OVUM proposal for an architecture of integrated NT1 with or without the S interface provided

6.5 Cost of the terminal

The evaluation is based on the existing figures for the already existing NT1 as currently provided by the network operators. The evaluation is made in terms of savings realised on some functional blocks provision.

Figure 5 needs to be compared with figure 8 when the S-bus is provided, in this case the saving is 1 remote power functional block and the NT1 box. Figure 5 needs to be compared with figure 9 when the S-bus is not provided, the saving is 2 S modules, 1 remote power module and 1 box, the savings in term of percentage are based on a telephone terminal.

The following table 2 gives the details, and indicate the savings in term of ECU and of percentage. However it was difficult to indicate a percentage for the terminal adaptor, as the global cost is unknown and depends of the type of TA concerned.

Table 2: Economic evaluation of the scenarios identified by the European Commission

Saving Configurations	S	Sw	R.P.	B	% of NT1	ECU		% Savings	
						(1)	(2)	(1)	(2)
TE + U + S	0	0	1	1	23	34,5	23	8,6	6,5**
TE + U	2	0	1	1	53	79,5	53	19	15
TA + U	2	1	2	1	78	117	78	?	?
								(NOTE)	(NOTE)

S : S functional block.
Sw : Switch functional block.
R.P. : Remote Power functional block.
B : Box.
(1) : Cost of NT1 = 150 ECU, cost of ISDN delivery = 400 ECU (OVUM).
(2) : Cost of NT1 = 100 ECU, cost of ISDN delivery = 350 ECU (based on present situation).
** : OVUM analysis : 40%.

NOTE: The percentage depends of the ISDN delivery cost which is, for the time being, not estimated.

The figures which do not take into account the cost of the U box and the software update in the network must be compared with the 40% savings which were announced by OVUM. Taking into account the globality may leads to even smaller savings.

6.6 Cost of the cabling and plug and socket

Not evaluated yet but will obviously reduce the interest of the U-interface.

6.7 Cost of the U box

The difficulty is in the evaluation of the real complexity of the U box, which may vary from some ECU (e.g. 20) for a very simple U box, to several hundred of ECU in the case where the U box is used to reconstitute the U-interface at the user side when the medium used in the network is different from the metallic cable pair. The functionalities required for maintenance, even in the simple case have not yet been completely accepted.

6.8 Cost of the software update at the network side

The estimation provided by the ETSI members is, 4,48M ECU and 18 months will be necessary to develop, a further 4 months will be required to implement the software changes with the classical additional problem of interworking between the two versions of software.

7 Situation on primary rate in

7.1 Situation on standardisation on PRA in CCITT

Study Group XVIII worked on a question 20 during study period 1989 to 1992 covering as well aspects of the primary rate access.

There was one CCITT Recommendation agreed at the end of the study period which can be considered comprehensive and stable:

CCITT Recommendation G.962: "Access digital section for ISDN primary rate access at 2 048 kbit/s".

Although the question could have included any work on a transmission system specification for copper cables in the same sense as for the basic rate, no interest was shown by the members and no contribution was received on this subject.

NOTE: There is even no transmission system specification for the 2 048 kbit/s hierarchical level and any other bit rate similar to CCITT Recommendation G.961 in the CCITT, only some general aspects are provided in CCITT Recommendation G.921 which are unsuitable for implementation.

There was a further study question in Study Group XV for the definition of a transmission system for fibre cable based on the digital section Recommendation.

7.2 Situation on standardisation in ETSI

ETSI TM3 started in April 1990 to specify an ETS on the primary rate access digital section and it is already in the approval process as ETS 300 233. This ETS can be seen as the European subset of CCITT Recommendation G.962 because ETSI members have influenced the work in CCITT by contributing the results of ETSI efficiently.

Concerning the transmission system, there is a work item in the ETSI work program on an HDSL (High bit rate Digital Subscriber Line) transmission system which can support the primary rate access digital section besides a number of other applications. The output of this work will be an ETR and it is expected to be ready for approval at the STC level in autumn 1993.

The specification for HDSL (based on 2B1Q echo cancellation technology) will have two options which are not compatible, i.e. a three pair system and a two pair system definition.

Additionally, it has been made clear that the already existing (sometimes a number of) national systems will be maintained in the network and will continue for the future installation for dedicated situations because they are considered cheaper than HDSL.

There may also be a one-pair solution for dedicated situations as expressed by some network operators. TM3 may continue to describe other systems with other technologies e.g. CAP or DMT for the same applications. All this is required to make most efficient use of the existing copper networks by minimizing the need for expensive cable and pair re-arrangements and repeater installations. There are extensive studies in TM3 on new optical access networks which may use the coming new V5 interface standards also supporting the primary rate access. Those networks, especially those implementing the "Fibre to the Home" scenario will directly provide the interface according to ETS 300 011 at the customer premises.

Conclusions on the primary rate access

In current local networks there are already transmission systems in use, supporting primary rate access, for copper and optical fibre cables as well as using microwave technology.

Since these systems have not been standardised internationally they are all incompatible. There may even be several systems in one network, each optimised for a specific cable type (e.g. transverse screened cables and unscreened cables).

The situation is similar for optical fibres, and systems using different line codes are known (e.g. HDB3, 4B3T, 5B6T, 7B8T and 1B2B) which may even be manufacturer's proprietary systems.

The situation for the microwave technology is that mainly proprietary air interfaces are used, (including Intellectual Property Rights (IPRs)) using different modulation techniques, frequency ranges and codes.

Standardisation may reduce the number of system options for the optical fibre application but not for the copper network due to the increasing implications in copper networks with increasing bit rate and the required optimisation and cooperation with other systems on the same cable. There seems even less chance to improve the situation for microwave systems because the relatively low number of applications is not attractive for standardisation.

With ANs in the network, directly providing the ETS 300 011 interface, there will be at least 3 different interface presentations in one network at the customer premises, in case there is no NT1 function converting to the internationally standardised interface according to ETS 300 011. The number is likely to be 6 or more in one network and much more than 10 in Europe.

8 Conclusion and guide-lines

The careful analysis made by the task force leads to the following conclusions:

- 1) a few configurations have been identified which may encouraged the introduction of a U-interface:
 - connection of a unique ISDN multi-application terminal (e.g. a videotelephone) in a point-to-point configuration between the exchange and the customer terminal;
 - connection of a terminal adaptor for multiple existing terminals in a point-to-point configuration between the exchange and the customer terminal adaptor.

However, in both cases, no extension is possible without a change of customer in-house installation, and the creation of an NT1 and S bus configuration. The use of both S and U-interfaces require two different families of terminals, one to be connected to the S, and the other to be connected to the U. This contrasts with the existing situation where the same terminals can be used at both the S and T interfaces;

- an interest has been identified inside the PABX, for solving specific problems such as connection of dedicated terminals, use of a more simple transmission system, use of the existing cabling, however this was outside the mandate of the group and the interest of a standard would be, if and only if, this standard is used to open the terminal market also in the private networks;
- 2) the transmission systems so far defined are only for copper of wires and the two following points need to be taken into account in the evaluation:
 - the network evolution, from copper to fibre or other media;
 - the definition of an interface either as an "internal network interface" or as a "user-to-network" interface;

- 3) additionally two major issues have been identified:
- the definition of a U box and the cabling characteristics between the U box and the terminal with integrated NT1, or a customer owned NT1;
 - the maintenance and associated parameters which need to be redefined with the existing testing equipments to be redesigned.

In conclusion, unless the economical studies prove the benefit of having the U-interface defined, based on the results of the technical evaluation the Task Group believe that unless there are solid arguments to support the economic and market benefit of introducing a U-interface it sees no reason to create an alternative U-interface standard, and, as based on this analysis it appears to offer little technical merit.

If a standardisation was also considered inside the private networks, this standardisation needs to be based on CCITT Recommendation G.960 and CCITT Recommendation G.961 and portability between the private and the public domain needs to be carefully considered at least for the most important common market segments (e.g. telephone, facsimile, and possibly videotelephony).

It may be noted that such a decision will definitively stabilise the existing ISDN standards so far defined inside ETSI and give confidence to the terminal manufacturers and the users on the life duration of the products. This will also be in line with the request from both the European Commission and IMIMG (a request shared by IMCC) to stabilise the Euro-ISDN standards for at least a three year period.

History

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