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Contents

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Foreword

This ETSI Guide (EG) has been produced by ETSI Project Corporate telecommunication Networks (CN), and is now submitted for the Membership Voting phase.

The present document is part 1 of a multi-part EG describing the CN standardization analysis, as identified below:

Part 1: "Corporate telecommunication Networks (CN); Standardization analysis; Part 1: Strategy";

Part 2: "Corporate telecommunication Networks (CN); Standardization analysis; Part 2: Enhanced voice and non-voice services";

Part 3: "Corporate telecommunication Networks (CN); Standardization analysis; Part 3: Virtual private networks";

Part 4: "Corporate telecommunication Networks (CN); Standardization analysis; Part 4: Mobility".

Introduction

In 1988 the European Commission (EC) issued a standardization mandate (BC-IT-74-77) to CEN/CENELEC, in co-operation with CEPT, for the drafting of a set of European standards based on the work programme on private telecommunication networks (SOGITs No. 227). The main aims of this mandate were to provide for:

- an adequate level of interworking between private and public ISDN services, where the terminals that provide these services will have to operate in a "multi-vendor" type market; and
- interoperability within the private networks for private network services and related protocols, which will allow a multi-vendor environment (from a user point of view) with regard to terminals, ISPBXs and CENTREXs.

Responsibility for the mandate passed to ETSI in 1992 as a consequence of the agreement between ETSI and CENELEC on standardization for private networks. The present programme of standardization work for Corporate telecommunication Networks (CN) pursued by ETSI within the scope of BC-IT-74-77 thus remains mandated standardization work.

In 1993 the EC confirmed that "*the political mandate to prepare a set of standards as defined in the standardization mandate from 1988 (e.g., SOGITs No. 227) continues to be applicable*". The Commission demonstrated this continuing political desire by forwarding a new mandate, BC-T-326, to ETSI in mid-1995. This new mandate concerns "the establishment of voluntary standards covering the elements involved in Corporate telecommunications Networks".

Mandate BC-T-326 recognizes the need to develop further standards in the area due to:

- the various interest groups involved (e.g., network operators, equipment manufacturers and end users);
- the changing environment of corporate telecommunications (e.g., increasing importance of Virtual Private Networking, changing regulatory environment, impact of the Bangemann report, etc.).

Responsibility for the mandate was allocated initially to TC-BTC and later transferred to the ETSI Project Corporate telecommunication Networks (EP CN). TC-BTC, and latterly EP CN, prepared a multipart report, of which this EG is one part, to fulfil the first part of the new mandate with a proposal for a further work programme in the area.

1 Scope

This ETSI Guide (EG) is part of a multipart EG containing the results of a strategic analysis, undertaken by ETSI Project CN, to satisfy the requirements of part 1 of the Standardization Mandate BC-T-326 [1] (see annex B).

Part 1 of the Mandate is concerned with the conduct by ETSI of a study into the future standardization work required to achieve the goal of covering all the elements involved in Corporate telecommunications Networks (CN), including aspects of interoperability between public and private domains and demonstration of that interoperability. This goal is the "Purpose" of the Mandate.

NOTE 1: The terms "private domain" and "public domain" should not be mixed up with the terms "private network" and "public network". Within the context the Mandate BC-T-326 and the CN project, the terms "private domain" and "public domain" should be understood to mean (respectively), those parts of a CN that belong to a customer (i.e., the corporation) and that are usually on his premises, and those parts of a CN that are part of the public network infrastructure.

The analysis identifies:

- where ETSI is today in its work programme for CN (i.e., the content and status of the work programme known as the "CN project");
- where ETSI needs to be, to have fulfilled the requirements of the mandate BC-T-326;
- options and recommendations for moving from the present situation towards the objective; and
- proposals for the new work items required, and a plan for achieving them.

The analysis takes account of the fact that responsibility for CN standardization is shared between ETSI and ECMA through the Joint ETSI/ECMA Agreement [17]. It also takes into account that standardization work for CN may be sub-contracted to ETSI Technical Competence Centres.

The scope of the Mandate is wide ranging; however, the results presented in this EG are based on general considerations applicable to the 3 main subjects within the CN project. These subjects are:

- enhanced voice and non-voice services;
- virtual private networks (VPN); and
- mobility within a CN.

The analysis identifies and presents several strategic principles based on these considerations. These are contained in this EG. However, the application of these principles to each of the specific subject areas is outside the scope of this EG.

NOTE 2: Application of the principles is covered in other parts of this multipart EG.

Management of a CN, performance of a CN, and broadband CN have not yet been specifically considered, although the strategic principles identified in this EG probably apply to these subjects also.

2 References

References may be made to:

a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or

b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or

c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or

d) publications without mention of a specific version, in which case the latest version applies.

A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] BC-T-326 (1995): "Draft standardization mandate forwarded to CEN/CENELEC/ETSI in the field of information technology and telecommunications - Corporate Telecommunication Network Standardization".

[2] CIGREF (1995): "Proposal for a minimum set of interworking functions".

[3] ETR 076 (1996): "Integrated Services Digital Network (ISDN); Standards Guide", 4th edition.

[4] ETR 130 (1994): "Methods for Testing and Specification (MTS); Interoperability and conformance testing; A classification scheme".

[5] ETR 171 (1995): "Business TeleCommunications (BTC); Virtual Private Networking (VPN); Services and networking aspects; Standardization requirements and work items", 2nd edition.

[6] ETR 301 (1996): "Users' expectations for Virtual Private Networks".

[7] ETR 304 (1996): "Methods for Testing and Specification (MTS); The future in ETSI of Quality of standards-making, Validation and Testing".

[8] TR 101 019 (1997): "Users' expectations for mobility".

[9] EG 201 026-2 (1997): "Corporate telecommunication Networks (CN); Standardization analysis; Part 2: Enhanced voice and non-voice".

[10] EG 201 014 (1997): "Methods for Testing and Specification (MTS); Technical quality criteria for telecommunications standards".

[11] ETS 300 415 (1996): "Private Integrated Services Network (PISN); Terms and definitions", 2nd edition.

[12] ETSI (1993): "Strategic Review Committee on Corporate Telecommunications Networks - Report to the Technical Assembly".

[13] ETSI (1995): "Making international standards happen first in Europe - A report from the high level task force".

[14] ETSI (1996): "Global Multimedia Mobility (GMM) - A Standardization Framework".

[15] ETSI (1996): "SRC6 Final report on European information infrastructure - Part A: Summary and recommendations".

[16] ETSI (1996): "SRC6 Final report on European information infrastructure - Part B: Main report and annexes".

[17] ETSI & ECMA (1995): "Agreement on the co-operation between ECMA and ETSI on standardization in the field of telecommunications", 6 October 1995.

[18] ISO/IEC 9646-1 (1994): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 1: General concepts".

[19] STATELY Delgationen (1995): "SOTIP - The Swedish Government Open Telecommunication Systems Interconnection Profile".

[20] The Bangemann Report (1994): "Europe and the global information society. Recommendations to the European Council".

[21] ETR 018 (1995): "Integrated Services Digital Network (ISDN); Application of the Bearer Capability (BC), High Layer Compatibility (HLC) and Low Layer Compatibility (LLC) information elements by terminals supporting ISDN services".

[22] ETR 299-1 (1996): "Integrated Services Digital Network (ISDN); Digital Subscriber Signalling System No. one (DSS1) protocol; Network Integration Testing (NIT); ISDN End-to-end testing".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the definitions contained in ETS 300 415 [11] apply. In addition, the following definitions apply:

behaviour guidelines: A profile defining the behaviour of two entities (e.g., terminal equipment, PINX, PISN) sharing a common interface, additional to the procedures specified at that common interface.

interconnection: A particular case of interoperability (the interoperability between two or more networks). Technically, interconnection is concerned with all the protocol "layers" at the Network-to-Network Interface (NNI), from the lower layers up to applications and supplementary services.

interface-to-interface interoperability relation: The interoperability relation between 2 interfaces.

interoperability: The ability of several products, pieces of equipment, networks, to perform together a set of functions (i.e., perform a "service") defined in specifications.

interoperability relation: An association or correspondence between one item and another, for the purpose of identifying and considering the interoperability between the items concerned.

interworking: The particular case of interconnection between heterogeneous networks. Interworking is achieved through "interworking functions", that realize protocol mappings between the two networks.

Interworking (MAPPING) specification: A specification describing the interworking of two protocols between which there is an interoperability relation.

peer-to-peer interoperability relation: The interoperability relation between 2 entities i.e., products, pieces of equipment, networks.

private domain: Those parts of a CN that belong to a customer (i.e., the corporation) and which are usually located on the customer's premises.

profile: A specification restricting the options in more general standards, to ensure interoperability between two implementations in a given context.

public domain: Those parts of a CN that are provided using the public network infrastructure.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

α	α reference point
CIGREF	Club Informatique des GRandes Entreprises Françaises
CN	Corporate telecommunication Network
CPE	Customer Premises Equipment
CT2	second generation Cordless Telephone
CTM	Cordless Terminal Mobility
DCS1800	Digital Cellular System 1800
DECT	Digital European Cordless Telephone
DSS1(+)	Digital Subscriber Signalling system No. 1 (enhanced)
ECMA	European association standardizing information and communication systems
EII	European Information Infrastructure
EN	European standard
ETR	ETSI Technical Report

ETS	European Telecommunication Standard
EURESCOM	European Institute for Research and Strategic Studies in Telecommunications
GII	Global Information Infrastructure
GMM	Global Multimedia Mobility
GVNS	Global Virtual Network Service
HLC	High Layer Compatibility
HLTF	High Level Task Force
ICN	InterConnecting Network
ICS	Implementation Conformance Statement
IEC	International Electrotechnical Commission
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ISUP	ISDN Signalling User Part
ITU-T	ITU-Telecommunication standardization sector
IVN	InterVening Network
IXIT	Implementation eXtra InformaTion
LLC	Low Layer Compatibility
NNI	Network-to-Network Interface
No.	number
PABX	Private Automatic Branch Exchange
PAC	Programme Advisory Committee
PHS	Portable HandSet
PICS	Protocol Implementation Conformance Statement
PINX	Private Integrated services Network eXchange
PISN	Private Integrated Services Network
PMBS	Packet-Mode Bearer Service
PNNI	Private Network-Network Interface
PNO	Public Network Operator
PSIG	P reference point SIGnalling system
PSTN	Public Switched Telephone Network
PUM	Private User Mobility
QSIG	Q reference point SIGnalling system
SEP	Service Entry Point
SG	Study Group
SOTIP	Swedish Open Telecommunication systems Interconnection Profile
SPAG	Standards Promotion and Application Group
SRC	Strategic Review Committee
SSIG	S reference point SIGnalling system
TC	Technical Committee
TIA	Telecommunications Industry Association (USA)
TMN	Telecommunication Management Network
UPT	Universal Personal Telecommunication
VPN	Virtual Private Network
VTOA	Voice Telephony Over ATM

4 Objectives of the analysis

4.1 Background - why we are doing it?

The standardization mandate BC-T-326 (see annex B) concerns:

> " *... the establishment of voluntary European Standards covering the elements involved in Corporate Telecommunication Networks. These elements include, inter alia, Telecommunication Terminals, Leased Lines, Public Network Services such as Centrex, Virtual Private Networks and Switched Network Infrastructures. The interoperability between private and public domains for the purpose of Corporate Telecommunication Networks should also be covered by the standards and the standards should include specifications as to how interoperability of elements conforming to the above standards can be demonstrated.*"

The justification for the mandate, and thus the background to the analysis and the reasons for doing it, are also clearly spelt out in the mandate. The justification is:

> "*The need to ensure that standards permit the widest possible range of customer facilities in the construction of Corporate Telecommunication Networks. This need is clearly spelt out in the Action Plan contained in "Europe and the global information society. Recommendations to the European Council" (The Bangemann Report) under the subchapter: "Interconnection and Interoperability."*
>
> *There is a need to develop further standards in this area due to the various interest groups involved:- network operators, terminal equipment manufacturers and end users. It should be noted that standards involved in this area can straddle both Mandatory and Voluntary regimes and Corporate Telecommunication Networks are often world-wide.*
>
> *ETSI has recognized the importance of this area, which is covered by several Standardization Work Areas. To that effect a mandate, BC-T-245, was launched by the commission to support the conformance testing activities in this area. Under mandate BC-IT-74 - 77 some of the standards for interworking between private and public services have been developed (QSIG etc.)."*

4.2 Starting assumptions and constraints

There are several assumptions and constraints underpinning the analysis. These are:

1) New work proposed under the mandate will have to take into account the large quantity of standardization work already achieved in the field over the last 8 years. Thus proposals coming from this analysis should be evolutionary, not revolutionary.

2) The regulatory nature of the telecommunications sector is changing, and this shall be taken into account.

3) There has been no fundamental change in the market requirements as documented and concluded by SRC5, except to say there is an increasing trend towards considering CNs from the point of view of service provisioning across an organization rather than in any technology related manner. In addition, services related to mobility have assumed great importance and shall be considered in an integrated manner together with other aspects of CN.

4) The present work programme for CN standardization (the "CN project") is proceeding in broadly the right direction.

5) There is still a very low level of interaction between private domain and public domain capabilities that does not permit users to construct hybrid arrangements.

4.3 Issues to be resolved

The analysis will seek to provide answers to the following key questions:

1) What standards presently exist for CN in both the private and public domains?

2) What are the Users' requirements that shall be satisfied by the CN project?

3) How should ETSI integrate standards applicable to the private domain of a CN and standards applicable to the public domain of a CN in a framework that permits vendors from both sides of the public/private divide to compete alongside one another?

4) How can full interoperability be achieved for a specified set of telecommunication services? What is the mechanism (e.g., profiles, ICS proformas) for achieving this? A secondary question, based upon users' requirements, is what services should that "set" contain?

5) How can interoperability be demonstrated? What are the objectives for any envisaged test specifications?

6) Is there a need for further standardization at the S reference point? Are any additional standards required to ensure functional continuity between the S reference point and other reference points (in particular, T and Q)?

7) What further standardization may be needed in specific technical fields, such as VPN, Mobility in CN, and broadband CN?

8) What is the relationship between European and World-wide Standards for CN? What should ETSI's policy be on the endorsement of International Standards for CN?

9) What high profile short term problems are presently impeding progress, and what strategies are there for solving them?

4.4 Structure of the analysis

Clause 5 summarizes users' requirements in each of the 3 subject areas and identifies major influences on the definition of the further work programme. Clause 6 contains an analysis of the present situation, the environmental factors affecting the CN project, and the strategic issues facing CN standardization. In clause 7, the strategic goals for the CN project are presented. The goals are elaborated in conjunction with the major influences identified from the users' expectations. In clause 8 one particular goal, that of "standards for interoperability", is elaborated in greater detail because of its central importance to the mandate.

Appropriate recommendations for guiding the future work of the CN project appear at points in the text where they can be logically derived from the analysis.

Conclusions and a summary of the recommendations are presented in clause 9. Work items that can be derived from the recommendations are also given in clause 9.

NOTE: Application of the strategic goals to the subjects of the CN project (e.g., enhanced voice and non-voice services, VPN, mobility, etc.) is covered by other parts of the present document.

Annexes to the analysis (annexes A - F) contain supporting technical material.

5 Users' expectations

5.1 Enhanced voice and non-voice services

Users expectations for enhanced voice and non-voice services are documented in several sources:

- "SOTIP" (Swedish Open Telecommunication systems Interconnection Profile) [19], developed by STATTEL Delgationen as a tool to help government buyers to choose appropriate telecommunications services and functions in a competitive market. SOTIP defines several end-users types and identifies the telecommunications services required by them and their organizations, independently of any technical solution.

- "CIGREF proposal for a minimum set of interworking functions" [2], written by CIGREF (Club Informatique des Grandes Entreprises Françaises), defines a list of services required by large users to interconnect their terminals through open networks, whether they are terrestrial, satellite or radio links.

- "User's requirements; Mobility; Interworking and Interoperability between Networks" as described in [8], developed by the ETSI User Group, describes users' expectations for mobile communications. It focuses on issues related to inter-networking between public and private, fixed and mobile networks. In particular, the report

raises the problem of interoperability of services, due to a lack of coherence between public and private networks, and the need for service harmonization between public, private, fixed and mobile networks. The document lists the services selected as the most interesting ones among those generally offered, and assigns priorities for harmonization.

- "Users expectations for Virtual Private Networks" [6], again developed by the ETSI User Group, describes users' functional requirements for VPN. In particular, the report identifies a minimum set of functions for which interworking throughout a VPN should be guaranteed. Users consider that a VPN should offer the services usually available from Customer Premise Equipment (CPE) irrespective of the type of connection to VPN (simple terminal or Private Integrated services Network Exchange (PINX)). Their expectations shall be met by both operators and manufacturers since both contribute to the provision of the service.

The ideal conclusion would be for standardization to take account of all the services indicated by the 4 sources. But for resources reasons, this might be difficult to achieve. One means of prioritizing further work is by establishing a *common minimum set of services* for which users require full interoperability within a CN.

Recommendation 1: To prioritize the work and to make it more manageable, CN standardization should be based on a unified approach to minimum sets of inter-operable services, established according to the market need.

Moreover, such a set can be further prioritized by dividing it further into subsets.

A first subset, for example, could contain the services required by all types of users. But there are also services that are only applicable to specific types of users; they do not appear to be required by all types of users. These could be contained in a second subset.

Both SOTIP and the report on users' requirements for mobility define several categories of end-users. The ones described for the mobility domain are specific to the mobility aspects, whereas the types defined in SOTIP are more general; they cover all types of end-users, including the mobility aspect. Actually, the model employs a classification of users based upon job function, independently of the technical solution.

A common minimum set of services has been established for the enhanced voice and non-voice sub-project. It is described in part 2 of the present document[9].

5.2 Virtual Private Networks (VPN)

Users' expectations for VPN have been documented by the ETSI User Group, ETR 301 [6].

In addition to the service specific requirements, dealt with in subclause 5.1 above, the User Group has identified specific requirements with respect to:

- cost reduction;
- improvements to the way services are offered and the way management and security are dealt with;
- network performance;
- numbering and routeing; and
- types of access to VPNs and interfaces, including man-machine interfaces.

The main conclusions, and thus influences on the future CN work programme, are identified as:

1) (already mentioned above,) a VPN should offer the services usually available from Customer Premise Equipment (CPE) irrespective of the type of connection to VPN (simple terminal or Private Integrated services Network Exchange (PINX));
2) interfaces that permit access to both VPN services and public switched services are seen as the most cost effective solution;
3) standardization of the "feel and shape" of the man-machine interface for a minimum set of services is considered to be of great importance. This is particularly important in the area of cordless terminals;

4) VPN should be capable of providing different interfaces at any service entry point with due consideration to the corresponding type of network, technology and access: CPE or PSTN or ISDN or GSM or DECT or CT2, etc.;

5) the signalling systems to be used are not important from the user point of view, but should be industry standard signalling systems. Full transparency between public and private networks (and thus between signalling systems) is important;

6) users should not receive a lower level of functionality with VPN than they presently receive today through existing networks;

7) facilities for user network management and security are required.

5.3 Mobility

Users' expectations for mobility have been documented by the ETSI User Group, TR 101 019 [8].

Service specific requirements have been dealt with in subclause 5.1 above.

In addition, the User Group concludes that:

- finding the right balance between the use of private facilities and public services to meet mobile communication needs, and how to achieve mobile connectivity between them, will be the most important issue for users in the future;

- the ability to allow employees to communicate whenever they wish to/from wherever they are located is an increasingly important requirement; and

- VPN concepts will be applied to mobile communication systems.

The consequence of these conclusions from the standardization viewpoint is to put interworking between different networks and different technologies high on the list of priorities.

Ideas arising from the work of the User Group concern:

- the highest possible level of data exchange between networks for location registration and management purposes;

- the smallest number of different cases of interworking (expressed in the User Group's report as "interworking interface types"); and

- a common terminology and set of processes to activate the major services.

The User Group makes more than 20 recommendations, many of which cut across several projects (e.g., CN, CTM, DECT, GSM, ISDN), for how standardization in the mobility area should proceed.

The message conveyed by these recommendations is that standardization is expected to provide:

1) harmonization of the services with respect to existing networks;

2) harmonization of new and evolving interfaces in the different public and private wireless networks and fixed networks, including:

   - a minimum set of services available on any network, irrespective of the user terminal;

   - the same service invocation for the minimum set of services whatever the networks used;

   - interworking of networks and customer equipment;

   - interoperability of services and applications through all networks.

3) that users may get their home network services in all networks;

4) separation of service control functions from switching and transport functions;

5) personal mobility in addition to terminal mobility.

5.4 Testing

No users' expectations have been specifically documented with regard to testing. The requirements identified here are based on information provided by experts from ETSI TC-MTS.

Testing is a natural way of ensuring that pieces of equipment and/or services are effectively meeting functional expectations, that they are compatible, and that the technologies proposed are effective. Testing can be seen as a means to clarify what is offered to the market.

Ideally, and before an analysis of the real possibilities, testing may be expected, according to its position in the life-cycle of products and services, to:

- guide the users in their procurement choice, if the testing is performed before any decision to buy;
- allow users to better control the products or services that are delivered, for instance at the acceptance testing phase.

Testing is a costly activity, that requires technical competence. Users want to minimize their expense related to testing. In practice this means users require that products and services should have been tested before they buy them.

However, the question of "how much testing and hence the cost" is a commercial question, outside the domain of standardization. Standardization cannot imply, by promoting formal testing, that suppliers have to make massive investment in testing.

6 Strategic analysis

6.1 Present content of CN project

The CN Project covers the standardization activities related to corporate telecommunication networks. Already the subject of existing mandates (BC-IT-74 - 77) from the European Commission, this standardization area was investigated by a Strategic Review Committee, SRC5, in the years 1992 and 1993 to help ETSI define a work programme on CN. The content of the CN project today is a reflection of these two drivers.

SRC5, in their report [12], identified six major topics as being of highest interest to CN users. Besides these topics, there are a number of areas of work inherited from the work programme established as a consequence of BC-IT-74 - 77. Not unexpectedly, some of the areas of inherited work overlap with the subject areas defined by SRC5. After rationalisation, the CN project has been defined to consist of 7 sub-projects:

- Enhanced voice and non-voice services;
- Virtual private networks;
- CN Mobility;
- High-Speed/LAN;
- CN Management;
- CN Scenarios; and
- CN Performance.

NOTE 1: SRC5 also identified "Multi-media" as being a major subject of interest to CN users. This subject area has become an ETSI project in its own right. Although within the scope of the present standardization mandate, BC-T-326, the subject has not been investigated in this study.

NOTE 2: CN related work on mobility, although part of the CN Mobility sub-project, is also co-ordinated by the ETSI Cordless Terminal Mobility (CTM) project, where interworking with other (public) networks is concerned.

Annex C provides a technical overview of the components of a CN.

For each of the first 3 sub-projects listed above, annex D describes the content and summarizes the status (December 1996) of the standardization work in the sub-project.

6.2 The global context

Work related to CN standardization is also taking place in organizations outside Europe; for example:

- ITU-T: In contrast to ETSI, ITU-T does not cover many aspects of CN standardization. Until now these have been limited to service interworking between corporate and public networks at the T reference point. VPN activities have just recently started. The most important Study Groups (SG) are SG1, SG11, SG12, and SG13.

- ISO/IEC JTC1: Within the Joint Technical Committee No. 1 (JTC1) of ISO/IEC, subcommittee SC6 is engaged in standardization of Private Integrated Services Network. Both ECMA, and more recently, ETSI have A-liaison status with SC6, enabling them to submit European standards for adoption as International Standards via the fast-track procedure. This mechanism plays an important role in promotion of QSIG and other PISN standards at the World wide level.

  Co-operation has been established between ITU-T SG 11 and JTC1/SC6 on the specification of VPN.

  Within the context of its PISN work programme, ISO/IEC JTC1/SC6/WG6 considers it both desirable and achievable to specify a generic platform for mobility. Such a generic platform is intended to be compatible with multiple cordless technologies, including DECT, CT2, and PHS. Starting in Autumn 1996 ETSI and ECMA will contribute the specifications already completed for CTM to form the foundation of this new international initiative.

- GVNS Forum: The Global Virtual Network Service (GVNS) Forum promotes the standard of GVNS which is a global switched service supported by multiple (public) networks and which is offered to customers over PSTN and/or ISDN. While minimizing the need for dedicated network resources, GVNS provides private network functions to users at geographically dispersed (international) locations.

- Bellcore: Bellcore is about to specify city-wide or country-wide CENTREX, which is to serve a corporation via multiple exchanges of the public network equipment. This activity should be taken into account when specifying CENTREX capabilities in ETSI.

- TIA: Liaison with Telecommunication Industry Association (TIA) in the USA has been established. Work is proceeding to define a common set of definitions and terminology. The work may be extended to cover transmission planning for PBX networks and for trans-Atlantic corporate networks.

- Other bodies: There are numerous national and regional standardization bodies around the world which specify partial aspects of CNs, mainly limited to data transmission. However, interest in voice communication is growing and needs to be carefully monitored. Fora (for example, the ATM Forum and its VTOA and PNNI activities) have an interest also.

6.3 Existing standardization and the CN project

Since 1987 a huge amount of standardization has been accomplished at the European level in the corporate network domain. Standards are available in many areas (e.g., QSIG, DECT, ISDN, GSM, etc.) defining numerous features and supplementary services.

However, it is difficult for users to take full advantage of this standardization work. They often face many difficulties when designing and implementing corporate networks. Technical solutions are complex and require a high level of expertise. Users do not want to cope with complex technical problems -- they want only to consider the issues at a service and cost-justification level. They have to deal with service provisioning across an organization that requires complex combinations of architectures and carrier/manufacturers offerings. The future, with an increasingly competitive environment and wider technical capabilities, promises additional complexity.

If we want standardization work to be more useful for users, perhaps we need to undertake additional work? Work leading to standards that define seamless corporate networking capabilities and inter-operable sets of services in complex multi-carrier and multi-interconnecting network environments.

Recommendation 2: Future work on CN standardization should concentrate on end-to-end service interoperability for minimum sets of service at a global level (through a combination of different interconnecting and intervening networks, in both fixed and mobile networks).

However, there are problems that prevent the achievement of such a goal. These problems manifest themselves mainly through the working method and the organization. They are:

- the balance of power between the various commercial interest groups is not equitable. It is still very much biased towards the traditional public network operators;
- everywhere there is a "not invented here" syndrome, causing duplication of similar lines of work but with incompatible results. This prevents the achievement of interoperability;
- in-built barriers of the technical organization, namely:
  - the work depends upon effective co-operation between experts in various parts of the ETSI organization, and in particular, the willingness of committees to undertake work on a sub-contracted basis *in line* with the requirements of the lead committee;
  - the present vertically oriented organization of work into committees for particular technologies.

With such problems, users might receive the standards they so much want for seamless corporate networking, but it seems unlikely!

6.4 Increasing technological complexity

The technologies to support CN are becoming more and more complex.

6.4.1 Intelligent Networks/ISDN

The development of numerous supplementary services for ISDN and the development of Intelligent Network (IN) capabilities enable network operators to provide "corporate services and integrated VPN solutions" in the public domain that are in competition with PISN solutions based on leased lines and PABXs. This leads to the need for more complex architectures for CN that include a combination of PABX private networks, CENTREX and VPN. At the same time these new architectures have to cope with the technical differences between the public domain and the private domain.

Since the boundaries between the private and public domain are becoming more complex, we should try to disassociate from the network architecture approach by using the term "Service Entry Point" (SEP), instead of talking about "terminal interfaces" and "User-Network Interfaces". An SEP is a point at which CN services are presented without reference to any specific protocol or interface to be used. The concept was introduced during the work of the ETSI VPN Task Group [5].

Recommendation 3: The concept of Service Entry Points (SEP) should be adopted as a basis for defining CN functionalities independently of the means by which such functionalities are provided.

6.4.2 Mobile Networks

Mobile networks and technologies have been defined in addition to fixed services, and as separated systems. As in fixed CN, the boundaries between public and private domain will evolve because mobile network operators will in the future focus on mobile VPN and mobile CN services.

To provide users with a global service, VPN services have to include mobile users and mobility services. Interactions between mobile and fixed networks, integration of mobile users and networks in a CN have to be considered. Mobile and wireless service dimension also increases the complexity of CN architectures and introduce new boundaries and new network access points.

6.5 Regulatory evolution

Telecommunications deregulation will bring more licensed operators/providers into the market, providing more choice for the users. This will be especially so in the long distance network and VPN sectors. In the future, the regulatory environment within Europe will allow for the provision of public/private, fixed/mobile, voice/non-voice applications and services across several access/transport network architectures, several operators and service providers.

Deregulation brings more complexity in CN architectures by an increase of intervening and interconnecting networks (e.g., access to a long distance VPN network through the local loop by PSTN/ISDN indirect access) and by introducing new boundaries between the different carriers in the public domain of a CN. Interoperability of services in such complex CN architectures will require highly featured interconnection at the network - network interfaces (NNI) of carriers involved in the CN provision.

Recommendation 4: NNI standards should take into account the impacts arising from the need to ensure a seamless environment for corporate services.

6.6 Differentiation between competitors

Deregulation and competition will oblige carriers and service providers to differentiate. New services will be a key differentiating factor for a competitor. So in the future a new problem will arise: how to cope with the contradiction of developing, on the one hand, detailed and numerous standards for seamless CN services, and on the other hand, allowing vendors the freedom to differentiate their product and service offerings.

For CN standards a balance is required in the level of standardization between:

- standards that are so detailed or which define so many supplementary services that they inhibit innovation and service differentiation; and

- standards that are not precise enough or that are too "open" to permit multi-vendor/multi-operator CNs to be established.

6.7 Other factors

There are other, miscellaneous, factors that have to be mentioned. They are not particular to the CN project, but may influence the definition of the future work programme. These other factors are:

- the general problem that detailed work items may be created by a particular committee without a clear view of the level of commitment of Members in the wider subject area (and thus to the complementary work items needed in other committees);

- the problem of how to achieve a balance between spending effort on the boring tasks needed for the completion of standardization in a particular area, and moving on to new, unexplored, and intrinsically more interesting areas of standardization;

- the fact that the majority of effort directed towards standardization activities is of a voluntary nature. Marshalling resources to support a "grand plan" is difficult - in practice, activities are mainly driven by Member's interests and contributions.

6.8 Relevant analyses undertaken by ETSI

In 1995 and 1996 many groups within ETSI have looked at the situation in their own particular areas and have studied how standardization should move forward. These groups include:

- High Level Task Force (HLTF) and its following up group, TFIG;

- Programme Advisory Committee (PAC) panel on Global Multimedia Mobility (GMM);

- Strategic Review Committee No. 6 on the European Information Infrastructure (EII) and its follow-up group, the EPIISG;

- User Group panels on Virtual Private Networks and Mobility.

Since the scope of the CN project cuts right across many areas, much of the analysis undertaken and conclusions reached by these groups can be of direct relevance to the CN project also. We do not intend to repeat the analyses; all the information is readily available in the reports of those groups ([6], [8], [13], [14], [15], [16]).

6.9 Vision of the future

The analyses mentioned above paint more or less the same picture for the future European and global telecommunications environment. In particular, the HLTF and PAC have described the environment in the years after 2000 as one that is fully liberalized with many competing service providers, network operators and technologies. The reader is referred to part 3 of the report of the HLTF [13] for a detailed description of this view of the future. This view is broadly applicable to the CN environment also.

In this future it will no longer be possible to consider fixed networks and mobile networks, PISN and VPN, private domain and public domain, CENTREX and PABX etc. in isolation from one another. Each (both on its own and in conjunction with the others) has an impact on CN that is impossible to ignore. The danger is that if each area is allowed to continue to develop in isolation, users will never obtain the seamless operation they seek. With a clear "vision" of what is needed for "corporate networks" and a plan for convergence towards that vision, agreed and accepted by all, perhaps this problem can be solved?

Unifying these aspects into a single "vision" for corporate networks (in a similar manner to that done by GMM in the field of mobile communications) is the major challenge for the CN project.

6.10 EII Enterprise model

SRC6 has built a model (the Enterprise model; see the SRC6 report [15], [16]) applicable to the European and Global Information Infrastructure (EII/GII) environment and shown how this could be the foundation of future standardization activities. Other groups such as PAC and the User Group have attempted to use this model to derive an understanding of how to drive forward standardization in a manner that can cope with the coming liberalised and competitive environment.

The Enterprise model is an organisational model defining functions, and interfaces between the functions, to support a general framework of information industry "roles" (end users, information sources, structural roles involved in the production and distribution of information, and infrastructural roles providing networking services and distributed information processing/storage).

Each interface in the model may correspond to a combination of different standards supporting different roles and functions. Network related projects have been defined for the provision of the basic and enhanced telecommunications services required by EII. They cover network technology and interconnection, including IN, TMN and addressing. However, corporate users and networks have not been specifically addressed. CN issues are treated inside network related projects but are not separately identified and dealt with.

The EII policy of a seamless federation of interconnected inter-operable telecommunications networks and terminals and the Enterprise model could perhaps be applied to CN standardization as the unifying tool. The main difficulty to be surmounted is that the Enterprise model is at a much higher level of abstraction than the CN project has traditionally been used to. Education and training may be needed before the model can be usefully used.

6.11 Strategic issues facing the CN project

All interest groups concerned with the provision of equipment or services to support CN are subject to a regime in which their freedom to respond to market demand (innovation) has to be balanced against the political goal of developing efficient and effective pan-European telecommunication systems. This regime is based in part upon regulation, and in part upon the various financial incentives used to stimulate standardization, infrastructure and application development.

In our view there is much in common between the strategic issues identified for other standardization projects (for example, by PAC on Global Multimedia Mobility as described in [14]) and the strategic issues facing the CN project. Contemporary standardization projects have to take account of the following facts:

- the nature of the telecommunications sector is changing in commercial, regulatory, and technological terms;

- there is more than one way of meeting the user's requirements, coupled with the "individualisation" megatrend. The current approach towards standardization will not solve the problems. The current approach assumes consensus between the players can be achieved. Increasingly, this is becoming less and less the case in the CN area;

- corporate telecommunications customers are highly demanding users in terms of price, functionality, and quality. Markets are highly competitive. Competing solutions are a fact of life;

- technology development and deployment does not wait for standardization; if standards are not available and there is money to be made, vendors offer proprietary solutions;

- technologies for supporting these types of applications evolve very quickly and often in conflicting ways. As well as backwards compatibility, "sideways" compatibility is a major issue. Users want to receive the same service regardless of the means by which it is provided.

It is to deal with these issues that the strategic goals of the CN project have been identified.

7 Strategic goals

7.1 Principal strategic goal

The principal strategic goal for the CN project is, and shall remain, the production of those standards appropriate for the development of the telecommunications market segment known as "corporate customers".

Behind this goal there is a fundamental requirement for a "vision" and a plan for convergence that unifies the disparate threads of standardization and the various interest groups. Such a "vision" is needed to act as a communication tool and as a road-map to what will be needed in corporate networks in the years ahead -- typically, to the year 2005.

Recommendation 5: The CN project should develop a "vision" of a corporate network in the year 2005, based upon the ideas of unification and converging standards, that achieves seamless service provision.

Besides the primary goal, several lesser (secondary) goals can also be identified.

7.2 Secondary strategic goals

7.2.1 Standards for interoperability

Support for corporate customers can be provided using various technologies. Initially, standardization focused on the adaptation of public ISDN standards to meet the private networking needs of corporate users. More recently this work has been supplemented to introduce mobility to corporate networks. Standards are now being supplemented to permit provision of service through VPN means. To avoid further segmentation of the market, a unified approach to market and service provision in a CN context is required to create user confidence in CN standards.

The required result, as foreseen by the Bangemann High Level Group on the "European information society", is that services and applications, although provided through different technologies, should be provided in a way that presents the user with a seamless environment. This goal is specifically mentioned in the "Bangemann Report" [20], as "... seamless interconnection of networks..." and "... the need for services and applications which build on them (networks) to be able to work together....". This is "interoperability".

To achieve this the focus of the standards activities shall be re-oriented.

In the future, CN standards will need to focus on interoperability and open platforms as well as on the implementation technologies -- a "transverse" approach, as well as a "vertical" approach. This is the first secondary goal:

"*Standards will have to assist the sector by enabling products and services based on different technologies to work together constructively to meet CN customer requirements.*"

Standards for interoperability are such an important part of the Standardization Mandate BC-T-326 [1] that they are explored in greater detail in clause 8 below.

7.2.2 Competing solutions

On one hand the distinction between private and public networks is becoming more and more blurred with the introduction of VPN in the public environment. On the other hand Public Network Operators (PNO) are bringing convergence between fixed and mobile services. In the future IN based networks will be used to provide mobility in fixed networks as well as additional services in mobile networks. Standardization work on VPN and Mobility in CN are good examples of the different families of solutions and approaches that can be used to provide the same services:

- standards for Cordless Terminal Mobility (CTM) have been developed to be used both in public ISDN and in PISN;
- Private User Mobility (PUM) solutions are being developed for PISN while public networks have defined UPT;
- two signalling systems are candidates for the access of a DECT Fixed part to a PABX (PSIG interface) -- QSIG and DSS1;
- VPN solutions are in competition with PISN and two signalling systems are candidates for the access of a PABX to a VPN: QSIG and DSS1+; and
- in the future VPN based on Broadband ISDN (B-ISDN) will be in competition with PISN using Broadband QSIG (B-QSIG).

Competing solutions are a way of establishing what the market wants or is prepared to pay for. In the short term, the CN project will pursue several parallel streams of work, each supported by its own interest group and respected by the others. In the long term, the CN project shall define plans for convergence of these parallel streams of work.

An important secondary goal is thus:

"The integration of parallel streams of development to achieve full interoperability between public and private domains, and... "

Where it is obvious that competing solutions are causing or could cause a detrimental effect on the market, practical steps shall be taken. These steps shall ensure convergence towards a single family of standards. Such convergence could be based upon the use of the standards first available (i.e., get rid of the "not invented here" syndrome) or upon harmonization at the service level.

At the same time CN standards shall be sufficiently transparent and sufficiently flexible to permit standards users (i.e., product/service suppliers) to develop their business in whatever direction they choose, without being severely constrained. A further secondary goal is, therefore:

" ... to ensure standards developed under the CN project do not impose constraints on the direction of commercial development."

The concept of convergence of standards, first seriously used in the proposals for GMM, should be applied to the CN project also -- by incorporation in to the CN "vision". To achieve it requires further significant strategic and tactical planning.

7.2.3 World wide standards

"World wide standards" means "adoption of standards at the international level, for World wide use".

CNs often span the World; therefore, World wide standards are required for CN to permit achievement of interoperability and economies of scale.

Both ETSI and ECMA have already enjoyed substantial success by having European standards and proposals adopted as the basis for World wide standards. The goal is simply:

"*To ensure standards developed in the future continue to be attractive for adoption at the World wide level.*"

In attempting to meet this goal, however, there are two issues to be managed.

The first is the cycle of development in Europe, proposal and adoption at the international level, and subsequent necessary re-alignment of the European standard. Although the process is different in the ITU-T and ISO/IEC cases, the result is the same. Namely, that failure to manage the cycle properly and failure to "lay the necessary foundations" at the international level can result in rejection or change by other regions, and substantial re-engineering at the European level. Clearly such re-engineering needs to be avoided wherever possible -- but not to the extent that Europe waits for standards to appear at the international level, only to find that technology has moved on and vendors are already offering proprietary solutions. Voice compression technologies, telephony over the Internet, and voice over ATM are all examples of where this is already happening.

To summarize:

"*Where World wide standards are not expected in a reasonable time scale European standards should initially be produced, and later contributed at the international level.*"

Even if World wide adoption turns out not to be possible for a particular standard, ETSI/ECMA should strive to ensure that it achieves maximum usage at the regional level (both European and non-European).

The second issue is the different standardization timescales affecting CN private domain standards and standards for the CN public domain. The latter are typically seen as the responsibility of those committees responsible for public network standards. In such committees the development cycle is longer and closely related to developments in ITU-T. Related to this is the question of how to manage the consistency between public domain and private domain standards when they are produced by different groups of people. Only by the establishment of clear objectives, based on the "vision" of what is needed, may this be achieved.

ETSI should promote, at the international level, a global approach for CN standards based on standardization of a minimum inter-operable set of end user services in a CN environment.

7.2.4 Maintenance of standards

When production of first editions of the required standards and reports has been completed there is a need for a maintenance activity. In a complex project like CN it is always the case that maintenance activities on completed work items will be required whilst other work items are still undergoing their initial development. Maintenance is elevated to the level of a strategic goal because of the extent to which European work forms the basis for global standards in the field.

Maintenance shall include a programme for maintaining alignment of ETSs for QSIG with the International Standards on the same subject, and for effectively maintaining the International Standards. Europe has some obligation with respect to the latter.

NOTE 1: ECMA TC32, as the body mainly responsible for maintaining this alignment, has kept this matter under review during 1996 and will continue to do so. ECMA TC32 is presently reviewing the approach to "Endorsing ENs" to find ways of making the process more efficient. The result of this review is not expected until mid-1997.

In addition, maintenance is necessary to introduce corrections and updates required for any other purpose e.g., as a result of problems encountered during implementation.

NOTE 2: There are, for example, a number of areas in the standards for both "QSIG" and "SSIG" where maintenance work is needed. One such example is to add the bearer services and teleservices that are not presently supported. A detailed record of other areas needing attention is maintained by ECMA TC32 Task Groups.

The goal therefore is:

"*Through a proper maintenance strategy, to ensure the continued compatibility of European and World wide standards, and to permit the introduction of corrections and updates required for any other purpose.*"

The CN project shall make provision for dealing with this activity on an ongoing basis. In general, it can be handled locally at the technical sub-committee level. Experience shows most problems are normally reported and recorded at this level anyway. However, co-ordination at the project level is needed to ensure that corresponding revisions take place elsewhere, and to ensure that interoperability continues to exist.

One practical measure, easily implemented, is that new editions of CN related standards should contain an annex indicating how the new edition differs from the previous edition.

Recommendation 6: New editions of CN related standards should contain an annex indicating how the new edition differs from the previous edition.

8 Standards for interoperability - further elaboration

"*Standards will have to assist the sector by enabling products and services based on the different technologies to work together constructively to meet CN customer requirements.*"

This clause discusses the definition of interoperability. It examines the role of standardization from the specific points of view of achieving interoperability and demonstration of interoperability (testing).

8.1 Definition of interoperability

"Interoperability" is the ability of several products, pieces of equipment, networks, etc. to perform together a set of functions (i.e., perform a "service") defined in specifications. Such products, etc. are said to have an interoperability relation between them, that can be identified and characterized.

According to ETR 130 [4], interoperability can be qualified in more than one way; for example:

- at different levels: e.g., protocol interoperability, service interoperability;
- by layer: e.g., physical, data link, network, etc.; or
- according to the interoperability relationship: e.g., peer-entity-to-peer-entity, interface-to-interface, end-to-end.

The approach of describing interoperability in terms of interoperability relationships seems to offer most benefit in terms of meeting the requirements of the Mandate. Hence, this is the approach that has been adopted in this EG.

"Interface-to-interface interoperability" (or "interworking") is one particular case of interoperability (see figure 1).

NOTE 1: Network interconnection is another particular case of interoperability. It is the case of interoperability between two or more networks. Technically, interconnection is concerned with all the protocol "layers" at the Network-to-Network Interface (NNI), from the lowest physical layer, right up to the application layer. Interconnection may or may not involve interworking as well.

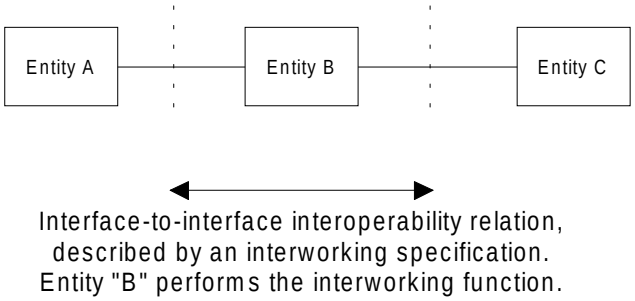

Figure 1: Interface-to-interface interoperability relation

Between entities with heterogeneous interfaces interoperability is achieved through "interworking" or "gateway" functions. Such functions implement protocol mappings (both information coding and information flows) between the interfaces of the two entities. This function appears as the mid-point in an "interface-to-interface interoperability relation". Interworking also occurs at points that have not traditionally been given such labels. One example is the interworking that occurs between the signalling system used on a PABX extension line with the signalling system used on an access to a local exchange.

To achieve interoperability in an interface-to-interface relationship requires 2 types of specification to exist. Firstly, for each of the interfaces concerned, the necessary protocol standards should exist. Secondly, there should be an adequate specification of the interworking between the 2 interfaces; this may be separate from the protocol standards (as in the case, for example of DSS1 to No. 7 ISUP interworking) or it may be part of them (as in the case of QSIG interworking with DSS1).

Successful interworking is insufficient to guarantee full interoperability if the behaviour of the interworking function is not consistent with that of its peers. Thus, there is a need to specify how the entities at each side of an interface should use and react to that interface. Figure 2 illustrates this "peer-(entity-)to-peer(-entity)" interoperability relationship, which can be described as a set of "behaviour guidelines".

NOTE 2: ETR 018 [21] (specifying the recommended encoding of BC, LLC, and HLC information elements) is an example of a set of behaviour guidelines.

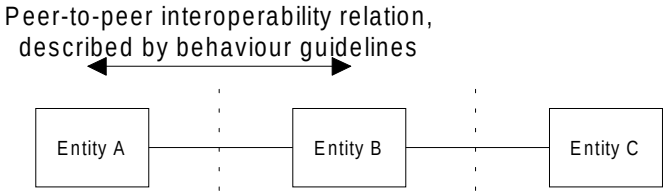

Figure 2: Peer-to-peer interoperability relation

Behaviour guidelines are a set of guidelines defining the behaviour of an entity (e.g., terminal equipment, PINX, PISN) additional to the procedures specified at an interface of the entity.

Both interworking specifications and behaviour guidelines may include a profile (in the sense of the word defined by ISO/IEC 9646-1 [18]). Because of the close association between them it will often be appropriate that the specification of the related behaviour guidelines and interworking appears in the same standard and is prepared by the same committee.

Recommendation 7: Related behaviour guidelines and interworking specifications should be documented in a common standard and should be specified by the same committee.

8.2 Achieving interoperability through the use of standards

To achieve interoperability by means of standards we can identify 5 "golden rules for standardization" that have to be followed. Together with an example of what they mean in the CN context, these are:

1) Having "enough" standards

   All the interoperability relationships are covered. For instance, all the protocols involved at the various stages in establishing an end-to-end connection are covered by the standards.

2) Having "good" standards

   The level of detail and the freedom from ambiguities is sufficient to ensure that interoperability does not depend on a common interpretation.

3) Having "bridges"

   Interworking specifications exist to specify the relationships between incompatible pieces of equipment, protocols, etc. Alternatively, differing technologies are designed in a co-ordinated and compatible manner (e.g., supplementary services for ISDN, CN, GSM, etc.).

4) Having "functional standards"

   Functional standards, or behaviour guidelines, restrict the choice of options in more general standards, to ensure real interoperability in a given functional context between two implementations.

5) Identifying, for each service, what the minimum level of interoperability is

Ensuring interoperability during the choice of equipment or during a commissioning phase can be facilitated by the availability of questionnaires allowing vendors to indicate clearly their support of standardized features and services (ICS/IXITs).

Systematic, practical, approaches have to be developed to apply these rules to determine whether interoperability has been achieved.

Subclause 8.4 proposes a method that systematically uses 3 of the 5 rules (rules (1), (3), and (4)) as criteria for considering the extent of interoperability in a particular area. This approach is generic and can be applied to different CN subject areas e.g., enhanced voice & non-voice services, VPN, mobility, etc.

Recommendation 8: The systematic method (proposed in this EG) for determining the extent to which interoperability has been achieved should be applied to the enhanced voice and non-voice services, VPN, and mobility sub-projects.

NOTE: The approach proposed in subclause 8.4 has been tested and used on the common minimum set of services defined in part 2 of the present document[9]. The results show where further standardization work may be needed to achieve end-to-end interoperability for a specific set of services.

For rule (2), the work (still in progress) of ETSI Project Team 76V on the "quality of standards" as described in EG 201 014 [10] is relevant and should be referred to. A practical means to apply the conclusions of Project Team 76V to the CN project still has to be developed.

For rule (5), see subclause 8.3.3.1.

8.3 Demonstration of interoperability

8.3.1 The role of standardization in testing

Testing is a costly activity, needed at various stages of the product/network life cycles; for example, debugging, acceptance testing, deployment testing, maintenance, etc.

Users aspire to be guided in their complex shopping activity, and to have a clear view of the functionalities offered, thanks to the results of "standardized testing". Can standardization effectively help?

Apart from regulatory purposes (approval of terminal equipment or network interfaces), standardization may have a role to play in testing when it is able, by its contribution, to facilitate the tests and reduce their costs. If standardization has a role to play, it is to facilitate a useful testing activity, not to add a useless testing activity.

Two approaches to standardized testing are conceivable:

1) Formal testing; that is to say:

   - a test carried out with formal procedures (based on standardized test specifications and methodologies);
   - a test carried out prior to the decision to buy;
   - a test carried out outside a given utilization, deployment, or commissioning context.

   Formal testing is examined further in subclause 8.3.2.

2) Support to testing activities performed in specific contexts of provision of network equipment or services; for instance, support to acceptance testing. Standardization as a support to existing testing processes is examined further in subclause 8.3.3.

8.3.2 Formal testing - keep it minimal !

Two kinds of formal testing can be envisaged:

- conformance testing i.e., testing to determine whether an implementation complies with the requirements of a specified standard;

- interoperability testing, i.e., testing leading to general declarations that product A and product B are compatible (also called compatibility testing or "box-to-box" testing; see annex E).

History has demonstrated the limits of formal testing (whether conformance testing or interoperability testing).

In the past, ETSI has produced extensive conformance testing specifications, to serve as the basis for formal testing. Conformance testing has appeared to be a costly activity, providing little confidence that products would effectively inter-operate and perform the requested functions.

Outside a given utilization, deployment, or commissioning context, the technical value of formal testing results is not very significant.

Formal interoperability testing has been and still is very difficult to achieve. It is closely related to the marketing strategies of competitive suppliers. Programmes of formal interoperability testing in the past (like the SPAG initiative, for example) have failed, despite the fact that they may have had a sound technical basis. Other programmes exist, in particular in the IT sector, that provide an exhibition of "compatibility matrixes" between manufacturers. The credibility of the information resulting from these programmes is barely recognized as anything more than an exercise in market promotion.

Moreover, formal interoperability testing between pairs of products or services is not without dangers. In particular (this list is not exhaustive):

- Demonstration of interoperability may give power to the first implementor, or to big implementers. Conformance with the original standard is no longer relevant, as the only way to have a product recognized becomes "conforming with the existing products". This situation is sometimes perceived as inevitable; the point is that a scheme of formal demonstrations of interoperability will not protect users against this situation.

- The cost of testing increases exponentially with the number of products on the market.

- Outside a specific context of responsibility for deploying or commissioning a specific network, and in the absence of a powerful independent arbitration party (an unrealistic concept), interoperability testing can lead to locked situations in which the different providers accuse each other of causing the non-interoperability.

This subject is dealt with in more detail in subclause 4.5.3 of ETR 304 [7].

Finally, two myths are often associated with interoperability testing:

1) "Interoperability testing is cheaper than conformance testing because it does not examine all the protocol details."

   This is not true. Interoperability testing is cheap... if the miracle of interoperability occurs as soon as products are powered on. When this miracle does not occur, understanding where the problems are is a complex and costly analytical activity. The other cost factor of interoperability testing is the need to test any product against any other.

2) "Interoperability is there; the only point is to demonstrate it."

   This is not often the case, and the main real use of interoperability testing is de facto to debug products and to find the proper tuning that will allow interoperability. Limited to a demonstration purpose, interoperability testing can quickly turn into a demonstration of non-interoperability.

In conclusion, formal testing has a limited value. This is true of formal conformance testing, as well as of formal interoperability testing. The reasons are commercial (too close to marketing strategies), economical (high cost of formal testing) and technical (testing outside a specific utilization or deployment context generally brings a limited technical result).

Formal testing supported by standardization (i.e., the production of standardized test specifications for formal testing) will not solve the users' problem. It is not by adding procedures of formal testing that the real testing problems would be solved. It would only increase the cost of deployment.

The question of "who should support the cost for testing", provider or user, is a commercial question, outside the domain of standardization. Standardization cannot implicitly decide that providers have to bear most of this cost by promoting formal testing (testing before any decision to buy). Standards in the CN project that specify formal testing should therefore be minimized. One way of achieving this might be to limit formal testing to "critical" interfaces. The

interfaces that can be regarded as critical in the CN context are probably those where two networks are interconnected, in particular between public and private domains.

Recommendation 9: Standards specifying formal testing (conformance and/or interoperability testing) for CNs should be limited to the interfaces between private and public domains.

8.3.3 Standardization as a support to existing testing processes

Apart from "formal testing", the role of standardization in testing should be to support "useful" testing processes. There are 2 possibilities, described in the following subclauses.

8.3.3.1 Identification of optional functions implemented

One aspect of demonstrating interoperability is being able to compare two entities to determine that they have implemented the same optional functions specified by a particular standard. This can be made easier if declarations of what is supported/implemented have been made in a consistent manner; consistency facilitates easy comparison, either by hand or by machine.

Such consistency can be achieved through the use of standardized proformas, such as those described by ISO/IEC 9646-1 [18] (ICS/IXIT).

Procurers may use such proformas to easily identify the functions and services implemented. Proformas also facilitate testing in heterogeneous environments, since they reveal which functions or services are implemented in a compatible and coherent way by the various pieces of equipment or networks.

EURESCOM, for example, has specified proformas that take account of functionality and service levels. These are used by PNOs to document the capabilities of their respective networks to permit the assessment of interoperability. Annex D (D.2) contains some examples.

Many standards for CN, particularly protocol standards, already include PICS proformas which to some extent facilitate such comparisons. However, there is quite wide variability in the quality and level of detail of some of these, which makes it difficult to use them for interoperability demonstrations. However, there is potential to improve this situation through the use of Requirements Lists and profile specific ICS proformas in both interworking specifications and behaviour guidelines.

Recommendation 10: Improve the means for equipment or service providers to document the capabilities of their implementations, and the options implemented.

8.3.3.2 Test purposes for demonstrations of end-to-end interoperability

A set of tests that allows "demonstration of the end-to-end provision of services" in a real specific network commissioning context can bring a genuine benefit to users. It can be used to help users specify the checking of the behaviour they expect from the delivered network or equipment.

Such tests can be used in a variety of contexts. Typically:

- incorporated in a test plan that forms part of a commercial contractual agreement (e.g., for acceptance testing);
- by network integrators to give customers confidence that the required services are properly rendered; or
- by partner organizations wanting to demonstrate that their products are compatible or that services are rendered correctly across heterogeneous networks.

Maximum benefit can be gained when such tests are specified in a manner that is independent of equipment or network architectures. In this sense, it is beneficial to standardize test purposes but to leave the specification of actual test cases to the specific implementation contexts. EURESCOM projects P.104 and P.412 have taken this approach for the public ISDN, and the work has been published by ETSI in ETR 299-1 [22]. ETSI should take a similar approach for CNs. Annex D (D.3) contains an example of such test purposes.

Recommendation 11: Produce test purposes (and not complete test specifications), similar to those produced by EURESCOM for the public ISDN, for end-to-end testing that are as independent of implementation architecture as possible.

8.4 An approach for determining the extent of interoperability

8.4.1 Reference scenarios

Subclause 8.2 identified 5 golden rules and suggested that a systematic method could be developed to apply (some of) these to the individual CN sub-projects. Such a method is explained in this subclause.

Using the general model of a CN illustrated in figure B.1 as a basis, "reference scenarios" can be derived. Each scenario is a subset of the general model and contains typical interoperability relations that exist between the various entities and reference points comprising that model.

Some typical scenarios have been generated in part 2 of the present document: EG 201 026-2 9] in the context of the enhanced voice and non-voice sub-project. In fact, 8 scenarios involving fixed private and public networks: PISN, ISDN and VPN have been used; however, these are only a representative selection and not the complete set. Further work is needed to identify all the scenarios to which the method should be applied.

Recommendation 12: Within the CN scenario sub-project, further work should be carried out to identify the specific scenarios to which the interoperability criteria should be applied.

In particular, to respond to user requirements on mobility and on VPN, further reference scenarios have to be developed and analysed which:

- integrate VPN service entry points (a1, a2, a3, b, c, d);
- take account of mobility aspects in VPN, PISN, and CTM, and interworking between both private and public domains and private and public networks; and
- integrate VPN service entry points for GSM/DCS1800 mobile users and DECT cordless users.

In addition, such reference scenarios may also prove to be useful in the search for common approach to CN performance parameters.

Recommendation 13: Reference scenarios should be considered by the CN performance sub-project for use in the search for a common approach to defining end to end performance in CNs.

Using the reference scenarios, the method consists of identifying the relevant interoperability relationships and systematically checking:

- the standards coverage for each interface;
- for sufficient specification of interworking for each interface-to-interface relationship; and
- for sufficient definition of behaviour guidelines for each peer-to-peer relationship.

To enable a check of the final end-to-end interoperability to be made, independently of the network architecture, functional test purposes have to be defined.

8.4.2 The method

Relevant interoperability relationships are identified by segmenting the whole end-to-end relationship of a reference scenario into smaller relationships determined (or bounded) by the entities and the reference points of the reference scenario. This is illustrated in figure 3.

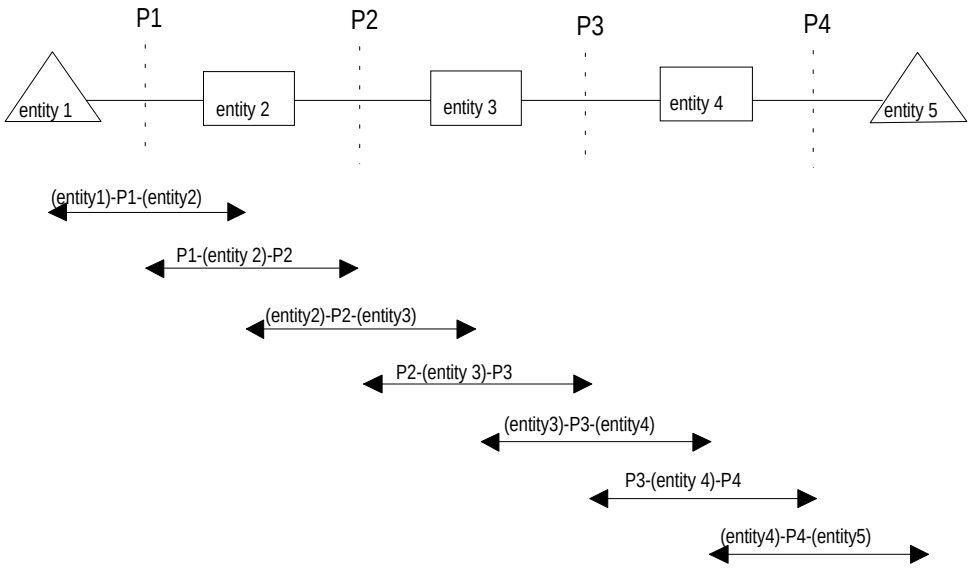

Figure 3: Segmentation of an end-to-end interoperability relation

Figure 3 shows the following relationships:

Peer entity-to-peer entity	**Interface-to-interface**
(entity 1)-P1-(entity 2)	P1 -(entity 2)- P2
(entity 2)-P2-(entity 3)	P2 -(entity 3)- P3
(entity 3)-P3-(entity 4)	P3 -(entity 4)- P4
(entity 4)-P4-(entity 5)	

The behaviour guideline for the relation «(entity 1)-P1-(entity 2)» will define a profile of the protocol at interface P1, and the interworking specification for the relation «P1 -(entity 2)- P2», should specify the mapping of this profile onto the protocol at interface P2 (through entity 2), as shown in figure 4. These two specifications being strongly related, they should appear in the same standard.

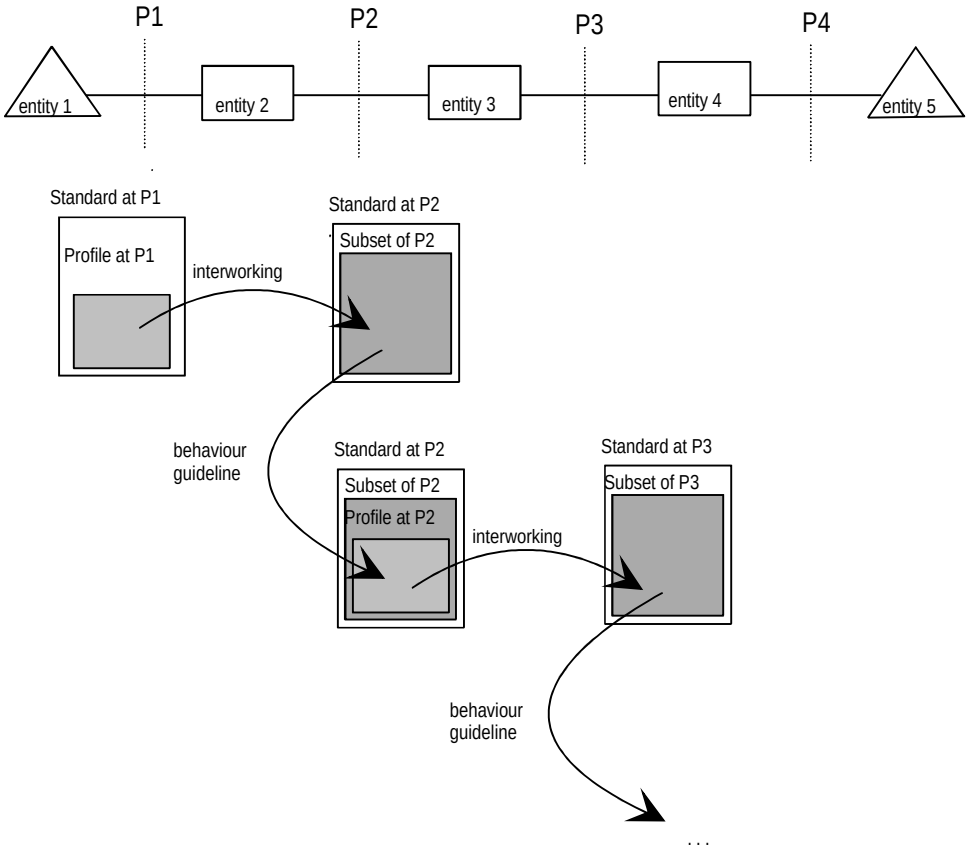

Figure 4: Application of the method to produce standards

The interworking specification for the relation «P1 -(entity 2)- P2» will define a subset of the protocol at interface P2. This subset should be used as a basis by the behaviour guideline for the relation «(entity 2)-P2-(entity 3)» for defining a profile of the protocol at interface P2. And the interworking specification for the relation «P2 -(entity 3)- P3», should specify the mapping of this profile onto the protocol at interface P3 (through entity 3). This is also shown in figure 4.

This method can be described in a number of steps that are applied to each reference scenario, and at each point where standards are found to be missing, "tasks" are proposed. Not all tasks will necessarily lead to corresponding work items, as there will be other factors (e.g., commercial need, possibility of rationalising several tasks within a single work item, etc.) to be taken into account. The method is systematic in that it identifies all the aspects that could help to achieve full interoperability. However, after identifying all the tasks they have to be further processed to generate relevant work items.

8.4.3 Step-by-step instructions

To carry out the method described above, the following steps should be followed:

Step 1: For each interface represented in the scenario:

a) check the existing standards for the interface, to ensure that standards are available for the basic services and for each of the supplementary services;

b) check, in a similar manner, the corresponding conformance testing standards for the interface.

Step 2: For each relevant functional entity, identify the interoperability relations between this entity and other entities of the scenario - the "peer-to-peer interoperability relations".

Step 3: For each peer-to-peer interoperability relation, determine whether behaviour guidelines are available and/or may be needed.

Step 4: For each relevant interface, identify the interoperability relations between this interface and other interfaces of the scenario - the "interface-to-interface interoperability relations".

Step 5: For each interface-to-interface interoperability relation, determine whether mapping/interworking specifications between the different protocols are available and/or may be needed.

Step 6: Identify the end-to-end interoperability relation and whether such interoperability has to be demonstrated for the relation (e.g., by using a set of architecture independent functional test purposes).

9 Conclusions, recommendations and work items

9.1 Summary of strategic goals

In summary, the strategic goals proposed for the CN project are:

- principally, the production of those standards appropriate for the development of the telecommunications market segment known as "corporate customers";
- through standards, to assist the sector by enabling products and services based on different technologies to work together constructively to meet CN customer requirements;
- the integration of parallel streams of development to achieve full interoperability between public and private domains, and to ensure standards developed under the CN project do not impose constraints on the direction of commercial development;
- to ensure standards developed in the future continue to be attractive for adoption at the World wide level; however, where World wide standards are not expected in a reasonable time scale European standards should initially be produced, and later contributed at the international level;
- through a proper maintenance strategy, to ensure the compatibility of European and World wide standards, and to permit the introduction of corrections and updates required for any other purpose.

9.2 Derivation of work items

This analysis has made a number of recommendations that can be used to guide the future work-programme. Specific work items, applicable across the range of CN sub-projects, can be derived from some of these. Specific work items applicable to particular CN sub-projects can also be derived. The former, in conjunction with the appropriate recommendations, are listed below. The latter are dealt with in other EGs of the series.

Recommendation 1: To prioritize the work and to make it more manageable, CN standardization should be based on a unified approach to minimum sets of inter-operable services, established according to the market need.

Work item 1: Develop, and agree ETSI-wide, a common minimum set of services for which users require full interoperability in a CN.

NOTE 1: Significant work on the above work item has already been undertaken by ETSI Project Team 85. The results are in contained in part 2 of the present document[9].

Recommendation 2: Future work on CN standardization should concentrate on end-to-end service interoperability for minimum sets of service at a global level (through a combination of different interconnecting and intervening networks, in both fixed and mobile networks).

None at present.

Recommendation 3: The concept of Service Entry Points (SEP) should be adopted as a basis for defining CN functionalities independently of the means by which such functionalities are provided.

Work item 2: Determine precisely what this means, and what impact it may have, for example, on stage 1 and stage 2 descriptions.

Recommendation 4: NNI standards should take into account the impacts arising from the need to ensure a seamless environment for corporate services.

None at present.

Recommendation 5: The CN project should develop a "vision" of a corporate network in the year 2005, based upon the ideas of unification and converging standards, that achieves seamless service provision.

Work item 3: Develop a "vision", based upon the ideas of unification and converging standards, of a corporate network in the year 2005 that achieves seamless service provision.

Recommendation 6: New editions of CN related standards should contain an annex indicating how the new edition differs from the previous edition.

No specific work items required.

Recommendation 7: Related behaviour guidelines and interworking specifications should be documented in a common standard and should be specified by the same committee.

Work item 4: Create an example of an interworking specification and behaviour guideline to show what is meant.

Recommendation 8: The systematic method (proposed in this EG) for determining the extent to which interoperability has been achieved should be applied to the enhanced voice and non-voice services, VPN, and mobility sub-projects.

Work item 5: Apply the systematic method for determining the extent to which interoperability has been achieved in the enhanced voice and non-voice services sub-project. This should not necessarily result in a formal deliverable, but in a plan for further work required.

NOTE 2: Significant work on the above work item has already been undertaken by ETSI Project Team 85. The results are in contained in part 2 of the present document: EG 201 026 [9].

Work item 6: Apply the systematic method for determining the extent to which interoperability has been achieved in the VPN sub-project. This should not necessarily result in a formal deliverable, but in a plan for further work required.

Work item 7: Apply the systematic method for determining the extent to which interoperability has been achieved in the mobility sub-project. This should not necessarily result in a formal deliverable, but in a plan for further work required.

Work item 8: Develop a practical means to apply the conclusions of Project Team 76V "quality of standards" to the CN project.

Recommendation 9: Standards specifying formal testing (conformance and/or interoperability testing) for CNs should be limited to the interfaces between private and public domains.

None at present.

Recommendation 10: Improve the means for equipment or service providers to document the capabilities of their implementations, and the options implemented.

None at present.

Recommendation 11: Produce test purposes (and not complete test specifications), similar to those produced by EURESCOM for the public ISDN, for end-to-end testing that are as independent of implementation architecture as possible.

None at present.

Recommendation 12: Within the CN scenario sub-project, further work should be carried out to identify the specific scenarios to which the interoperability criteria should be applied. In particular, to respond to user requirements on mobility and on VPN, further reference scenarios have to be developed and analysed which:

- *integrate VPN service entry points (a1, a2, a3, b, c, d);*

- *take account of mobility aspects in VPN, PISN, and CTM, and interworking between both private and public domains and private and public networks; and*

- *integrate VPN service entry points for GSM/DCS1800 mobile users and DECT cordless users.*

Work item 9: Develop CN reference scenarios that:

- integrate service entry points (a1, a2, a3, b, c, d);

- take account of mobility aspects in VPN, PISN, and CTM, and interworking between both private and public domains and private and public networks; and

- integrate service entry points for GSM/DCS1800 mobile users and DECT cordless users.

Recommendation 13: Reference scenarios should be considered by the CN performance sub-project for use in the search for a common approach to defining end to end performance in CNs.

Work item 10: Consider whether the CN reference scenarios are of any benefit in the search for a common approach to defining end to end performance in CNs.

9.3 List of incidental work item proposals

During the course of the investigations leading to the present document several miscellaneous/incidental pieces of work, specific to particular CN sub-projects, have been identified. These will need to be refined or expanded when considered in more detail. They are listed here as "things that need to be done":

Misc. item 1: Network management for CN - in the recent past (2 years) there has been little or no interest in this subject area within ETSI or ECMA.

Misc. item 2: Enhancement of QSIG to bring it in line with ETS 300 403 i.e., White book (1993) version of Q.931. Primarily, addition of PMBS, BC & HLC selection mechanisms. Work mainly affects Basic Call. Corresponding enhancement of test suite.

Misc. item 3: Enhancements to QSIG for the missing bearer services and teleservices -- primarily videotelephony.

Misc. item 4: Enhancements to QSIG for the maintenance items recorded by ECMA TC32.

Misc. item 5: Improvement of QSIG PICS proformas based on the approach taken by ETS 300 403-3.

Misc. item 6: Enhancements to QSIG for the conveyance of CN performance related information.

Misc. item 7: Updating of existing SSIG standards.

Misc. item 8: Enhancements to QSIG to permit satellite working.

Misc. item 9: Revision and ongoing maintenance of ETR 076 [3]. Aspects relating to VPN, mobility, CTM, B-QSIG, B-ISDN, etc. all need to be added. Work on representation of scenarios should be revised. Responsibility for the ETR should pass to the CN Project.

Misc. item 10: Completion of enhancement of CN reference configurations/scenarios to take account of mobility aspects. It is not clear whether actual new work is required, or whether it is just a matter of reaching consensus on some existing draft documents.

Misc. item 11: Implementation of the work items recommended in the VPN TG report that have not already been started.

Misc. item 12: Advice of charge -- the whole area of charging and accounting, particularly in relation to mobility.

Misc. item 13: Work items for protocol at P reference point.

Misc. item 14: Work items for protocol at S reference point - first requires resolution of what the objective of standardization at the S reference point is. Is it so that Euro-ISDN terminals can be used "behind PINX" or it to create service standards for use by Centrex terminals? See annex F.

9.4 Conclusions

The conclusion that can be drawn from the different sources of user's requirements is that there is a need to have full interoperability across several different types of network for a particular set of telecommunication services. The present technology oriented (vertical) approach used by ETSI and ECMA for service and network standardization does not permit this goal to be met. Given the current situation, the goal cannot be met in the short term, but a long term plan needs to be put into place to solve this problem. Before such a plan can be created, a "vision" of corporate networks in the long term is required.

Significant further work is required, not only to develop this vision and the supporting plan, but to integrate this approach, using the strategic goals and recommendations identified in this part, across all the sub-projects of the CN project.

Annex A:
Standardization mandate BC-T-326

The text in this annex is a reproduction of the text of standardization mandate BC-T-326:

EUROPEAN COMMISSION

DIRECTORATE-GENERAL III

INDUSTRY

Legislation and standardization and telematic networks

Standardization

Brussels, 8 March 1995

KHL/uk/5320-003

DGIII/B/2

M/92

SOGT 94/65.2

SOGITS N 797.2

BC-T-326

DRAFT STANDARDIZATION MANDATE FORWARDED TO CEN/CENELEC/ETSI IN THE FIELD OF INFORMATION TECHNOLOGY AND TELECOMMUNICATIONS

TITLE

Corporate Telecommunication Network standardization

PURPOSE

The purpose of this mandate is the establishment of voluntary European Standards covering the elements involved in Corporate Telecommunication Networks. These elements include, inter alia, Telecommunication Terminals, Leased Lines, Public Network Services such as Centrex, Virtual Private Networks and Switched Network Infrastructures. The interoperability between private and public domains for the purpose of Corporate Telecommunication Networks should also be covered by the standards and the standards should include specifications as to how interoperability of elements conforming to the above standards can be demonstrated.

JUSTIFICATION

This mandate derives from the need to ensure that standards permit the widest possible range of customer facilities in the construction of Corporate Telecommunication Networks. This need is clearly spelt out in the Action Plan contained in "Europe and the global information society. Recommendations to the European Council" (The Bangemann Report) under the subchapter: **"Interconnection and Interoperability"**.

There is a need to develop further standards in this area due to the various interest groups involved:- network operators, terminal equipment manufacturers and end users. It should be noted that standards involved in this area can straddle both Mandatory and Voluntary regimes and Corporate Telecommunication Networks are often world-wide.

ETSI has recognized the importance of this area, which is covered by several Standardization Work Areas. To that effect a mandate, BC-T-245, was launched by the commission to support the conformance testing activities in this area. Under mandate BC-IT-74 - 77 some of the standards for interworking between private and public services have been developed (QSIG etc.).

In order to ensure the timely development of standardization a project management approach is applied to Corporate Telecommunication Network standardization.

ORDER

This mandate constitutes in two parts to be implemented consecutively. The first part requires the preparation of an ETSI Technical Report (ETR) with a proposal for a work programme in the area of Corporate Telecommunication Network standardization. The second part, based on the options and possibilities identified in the ETR shall require the establishment of European Standards covering elements involved in Corporate Telecommunication Networks, and the specifications on how interoperability of the elements conforming to the above standards can be demonstrated.

RECOMMENDATIONS

The need for end users, special interest groups such as the IPNS Forum and industry associations like ECMA should be taken into account. Similarly, the experience of test laboratories and Notified Bodies is vital to the specifications on interoperability demonstration.

PROPOSED SCHEDULE

December 1995	Adoption of ETR
December 1996	Adoption of ETS(s)

ALIGNMENT WITH OTHER INTERNATIONAL WORK

Proposals for Corporate Telecommunication Network standardization shall be based on existing standards. In particular, account shall be taken of relevant work done in ETSI/CEN/CENELEC. As Corporate networking is of interregional interest alignment with equivalent activities in other regions, the ITU and in ISO/IEC should be ensured.

STANDSTILL

For the terms of Article 7 of the Directive 83/189/EEC, the standstill applies for the standards developed under this mandate.

PUBLICATION IN THE OFFICIAL JOURNAL

A title and summary in the 9 languages of the Community is required.

Annex B:
Technical overview of CN concepts

This annex presents a technical overview of a CN. There are several documents available (documents marked with a "*" in the bibliography, annex A) describing the CN concept from the technical viewpoint. The reader is referred to these.

Figure B.1 provides an overview of a typical CN.

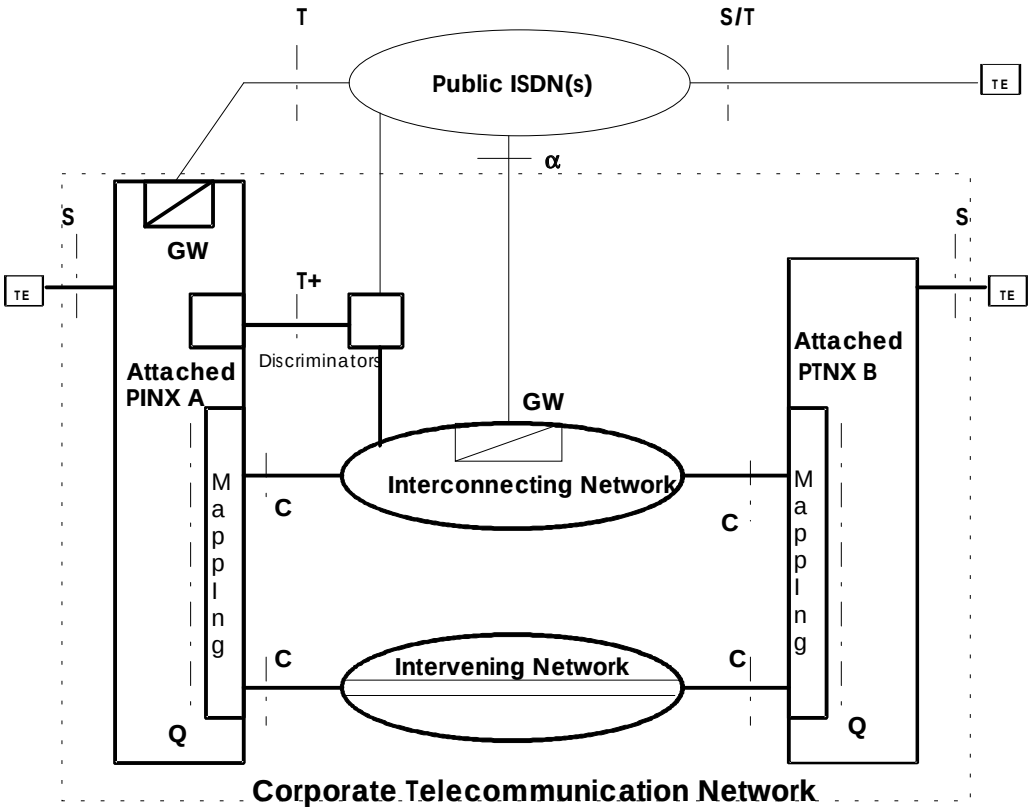

Figure B.1: Overview of a typical CN (simplified example)

In the trivial case a CN may consist of one PINX only. The CN in this example consists of two PINXs. The figure represents the simplest form of a typical example, the attachment of a CN to the public ISDN, the use of a public ISDN equipment based "Inter-Connecting Network" (ICN), and an "InterVening Network" (IVN). More complex configurations can also be constructed by applying the same principle in multiple ways.

The terminal equipment (TE) illustrated as attached at the S reference point may be wired (i.e., fixed) terminal equipment or it may be wireless/cordless terminal equipment.

The term "(attached) PINX" is a generic term covering both implementations in the private domain of the CN (i.e., on the customer premises, by means of an ISPBX), and implementations in the public domain of the CN (i.e., within the infrastructure of the public network (e.g., IS-Centrex), or provided by a 3rd party Service Provider).

The two attached PINXs are interconnected via four different means:

- the public network (in this example: a public ISDN, via T reference points); this interconnection is external to the CN;
- an ICN via discrimination functions across a T+ reference point;
- an ICN via C reference points;

- an IVN via C reference points.

The latter three are within the CN, although the switching and/or transmission equipment typically is owned by a third party, e.g. PNOs.

The discriminator functions around the T+ reference point permit both PINX-to-public ISDN and PINX-to-ICN calls to be carried via the same interface, with dynamic sharing of user information channels and signalling capabilities.

A PINX can play one of two roles on a specific call. It can serve as an "end-PINX" (i.e., hosting the originating or terminating terminal equipment of that call) or it can serve as a transit-PINX, extending the call to/from another PINX that hosts the originating or terminating terminal equipment.

Gateway functionality (GW) in the ICN is an option that allows for the so called "Break-out" and "Break-in" of calls from/to the CN (i.e., interconnection between the CN and the public ISDN via the ICN). This function permits routeing of CN traffic from/to the most appropriate point for interacting with the public network (e.g., to reduce the public network call charges incurred).

With the exception of teleservices, CN standardization activities cover all relevant specifications on the definitions of terminology, architectural aspects, numbering, basic and supplementary services as well as additional network features (descriptions at all three stages, including signalling), performance, etc.

Annex C:
Present day status of CN sub-projects

C.1 General

This annex describes the status (December 1996) of the following CN sub-projects:

- enhanced voice and non-voice services;
- virtual private networks; and
- mobility.

C.2 Enhanced voice and non-voice services

C.2.1 Scope of sub-project

The enhanced voice and non-voice services sub-project comprises work in four areas:

- basic call and generic procedures necessary for the operation of telecommunications services in corporate telecommunication networks;
- basic and supplementary service specifications for the support of voice and non-voice applications;
- interworking of these services with those of the public network; and
- interaction of these services with other services of the public and private domains.

These aspects are taken account of in service descriptions, signalling requirements and signalling protocols. Practically, this results in standards for:

- layer 2 protocol standards for operation across interfaces at the T, Q, and S reference points, including conformance test specifications, PICS, and PIXIT as appropriate;
- layer 3 basic call and generic procedures for D-channel protocol operation across interfaces at the T, Q, and S reference points; including conformance test specifications, PICS, and PIXIT as appropriate; and
- for each telecommunications service:
    - stage 1 description;
    - stage 2 description;
    - stage 3 description (layer 3 protocol standard, DSS1) for ISPBX/PISN access (via an interface at the T reference point) to the public ISDN;
    - stage 3 description (layer 3 protocol standards, QSIG) for inter-exchange signalling in PISN (via a notional interface at the Q reference point);
    - stage 3 description (layer 3 protocol standard, SSIG) for terminal access (via an interface at the S reference point) to the CN;
    - protocol implementation conformance statements (PICS) for each of the stage 3 description types (for both the user and network sides of the interface where applicable);
    - conformance test specifications, and protocol implementation extra information (PIXIT) for each of the stage 3 description types (where applicable).

With the exception of protocols at the T reference point, responsibility for standardization in this sub-project lies with ECMA TC32. Protocols at the T reference point are the responsibility of TC-SPS, with close support from ECMA TC32 for aspects concerning interworking with PISNs.

The content of the enhanced voice and non-voice services sub-project and its status is summarized in the following subclauses. For further detail, see the ISDN Standards Guide, ETR 076 [3].

A number of standards have been developed by ECMA and submitted both to ETSI to become ETSs and to ISO/IEC to become International Standards. In the process some technical misalignments have arisen between the 3 sets of standards. This has needed the so called "ETS/IS Alignment Programme" and the "ECMA-tisation programme" to bring the 3 sets of documentation into alignment once more. At the same time, the "process" is being changed to ensure that such mis-alignments are minimized in the future.

C.2.2 Content and status of work items

C.2.2.1 Layer 2 protocol standards

The following layer 2 protocol standards have been published:

- ETS 300 402-1: "Integrated Services Digital Network (ISDN); Digital Subscriber Signalling System No. one (DSS1) protocol; Data link layer; Part 1: General aspects"; and

- ETS 300 402-2: "Integrated Services Digital Network (ISDN); Digital Subscriber Signalling System No. one (DSS1) protocol; Data link layer; Part 2: General protocol specification".

These standards incorporate data link layer requirements for both private and public networks, and supersede older standards where the requirements for private and public networks were dealt with separately. Part 4 of this standard (ETS 300 402-4) contains the PICS proforma.

Conformance test specifications for the part applicable to the use of the data link layer protocol between two Private Integrated services Network eXchanges (PINX) at the Q reference point, including the PIXIT, are contained in the following ETSs:

- ETS 300 804-1: "Private Integrated Services Network (PISN); Inter-exchange signalling protocol; Circuit mode basic services; Data Link Layer (DLL); Part 1: Test Suite Structure and Test Purposes (TSS & TP)";

- ETS 300 804-2: "Private Integrated Services Network (PISN); Inter-exchange signalling protocol; Circuit mode basic services; Data Link Layer (DLL); Part 2: Abstract Test Suite Specification (ATS)".

These ETSs are expected to be published in May 1997.

C.2.2.2 Layer 3 basic protocol standards

The basic procedures for signalling in PISN are combined with the stage 1, 2, and 3 descriptions of circuit-mode bearer services, and teleservices. The stage 3 description of the Identification supplementary services is contained within the layer 3 basic procedures. The following standards have been published:

- ETS 300 171 (ECMA-142): "Private Integrated Services Network (PISN); Specification, functional models and information flows; Control aspects of circuit mode basic services";

- ETS 300 172 (ECMA-143): "Private Integrated Services Network (PISN); Inter-exchange signalling protocol; Circuit-mode basic services";

- ETS 300 190 (ECMA-156): "Private Telecommunication Network (PTN); Signalling at the S reference; point Generic keypad protocol for the support of supplementary services";

- ETS 300 192 (ECMA-106): "Private Telecommunication Network (PTN); Signalling protocol at the S reference point; Circuit mode basic services";

- ETS 300 239 (ECMA-165): "Private Integrated Services Network (PISN); Inter-exchange signalling protocol; Generic functional protocol for the support of supplementary services"; and

- ETS 300 240 (ECMA-161): "Private Telecommunication Network (PTN); Signalling at the S-reference point; Generic feature key management protocol for the control of supplementary services".

ETS 300 172, ETS 300 239, and ETS 300 240 all contain PICS proformas. ETS 300 192 does not contain a PICS proforma.

For the QSIG layer 3 (i.e., the protocol defined by ETS 300 172 and ETS 300 239), conformance test specifications, including the PIXITs, are contained in:

- ETS 300 805-1: "Private Integrated Services Network (PISN); Inter-exchange signalling protocol; Circuit mode basic services; Network Layer (NL); Part 1: Test Suite Structure and Test Purposes (TSS & TP)";

- ETS 300 805-2: "Private Integrated Services Network (PISN); Inter-exchange signalling protocol; Circuit mode basic services; Network Layer (NL)); Part 2: Abstract Test Suite Specification (ATS)";

- ETS 300 806-1: "Private Integrated Services Networks (PISN); Inter-exchange signalling protocol; Generic functional protocol for the support of supplementary services; Part 1: Test Suite Structure and Test Purposes (TSS & TP)";

- ETS 300 806-2: "Private Integrated Services Networks (PISN); Inter-exchange signalling protocol; Generic functional protocol for the support of supplementary services; Part 2: Abstract Test Suite Specification (ATS)".

These standards are expected to be published in May 1997.

C.2.2.3 Service descriptions (stage 1, 2, & 3) at the T reference point

A large number of standards containing the stage 1, 2, and 3 descriptions of basic and supplementary services for the public ISDN have been published. Where appropriate, these take account of the requirements applicable at the T reference point. For detailed information, see ETR 076 [3].

C.2.2.4 Service descriptions (stage 1, 2, & 3) at the Q reference point

Technical work on the services in the list below has been completed, and the information has been published by ECMA. As noted above, a number of services are documented as an integral part of the basic call procedures. All the standards for the services in the list have been submitted for publication as ETSs, either directly, or as endorsements of the equivalent International Standards. Those marked with an asterisk (*) are expected to be published during 1997; all others have already been published.

Bearer services	**Supplementary services**
Circuit-mode 64 kbit/s unrestricted	Advice of charge*
Circuit-mode speech	Call deflection
Circuit-mode 3,1 kHz audio	Call forwarding busy
	Call forwarding no reply
	Call forwarding unconditional
	Call interception*
Teleservices	Call intrusion
	Call offer
Telephony 3,1 kHz	Call transfer
Telefax group 4	Calling line identification presentation
Videotex (circuit-mode only)	Calling line identification restriction
	Calling name identification presentation
	Calling/connected name identification restriction
	Completion of calls on no reply
Additional network features	Completion of calls to busy subscriber
	Connected line identification presentation
Clock synchronization	Connected name identification presentation
Common information*	Do not disturb (override)
Path replacement	Message waiting*
Transit counter*	Recall*

NOTE 1: There are no specific stage 1, 2, and 3 descriptions for the bearer services and teleservices. These services are documented as a part of basic call.

NOTE 2: A number of supplementary services, while supported at the S reference point, are either not applicable at the Q reference point, or are provided as part of basic call (e.g., Identification supplementary services).

NOTE 3: The terminal portability, call waiting, and call hold supplementary services have no explicit description, but provision is made for the relevant notifications where the service is operating elsewhere:

Standards for the following supplementary services are presently being drafted:

- Call distribution; and
- Call priority interruption.

C.2.2.5 Service descriptions (stage 1, 2, & 3) at the S reference point

As noted above, a number of services are documented as an integral part of the basic call procedures.

Specifications for the following services at the S reference point have been developed, and are documented as part of the basic call control procedures at the S reference point (see above):

Bearer services	**Supplementary services**
circuit-mode 64 kbit/s unrestricted	calling line identification presentation
circuit-mode speech	connected line identification presentation
circuit-mode 3,1 kHz audio	calling/connected line identification restriction
Teleservices	
telephony 3,1 kHz	
telefax group 4	
videotex (circuit-mode only)	

The subaddressing, multiple subscriber number, and terminal portability supplementary services are provided as an integral part of the basic call description (i.e., they are not recognized as supplementary services in their own right).

No other work is currently started on S reference point protocols due to priority being given to services at the Q reference point.

C.2.2.6 CN service interworking with the public ISDN services

CN service interworking with the public ISDN services at the T reference point is described in the stage 1, 2, and 3 standards for the relevant public ISDN services.

C.3 CN virtual private networks

C.3.1 General aspects and pre-normative investigations

Pre-normative investigations of VPN services in the CN context, leading to the identification of the present work items has been undertaken in 1994/95 by the VPN Task Group. The results were published in two documents, TCR-TR 034 and ETR 172 in Autumn 1995. These identical documents covered considerations related to service aspects and networking aspects. Early in 1996 2nd editions, incorporating additional considerations related to the support of VPN services based on an IN architecture, were published.

Pre-dating this activity, but to some extent overlapping it, STC-BTC1 has studied the "integrated scenario" for business communications. This resulted in TCR-TR 033 being published in Autumn 1995.

These two activities have approached the subject of VPN standards from different directions (public/DSS1/SSNo.7/IN direction and private/QSIG direction).

A picture of the new standards and the modifications to existing standards required is only just beginning to emerge. Further work is needed (part 3 of the present document: EG 201 026-3).

The subclauses below describe the detailed content and status of each of the work areas. The work is divided into two main areas of standardization: service aspects and network aspects.

Pre-normative work on the B-ISDN requirements for the support of Broadband Virtual Private Networks is presently being carried out.

C.3.2 Service aspects

Service aspects standardization is concerned with the services provided by the public network infrastructure. These can be categorized into:

- VPN end-user services offered to CN users (i.e., related to the "a" type service entry points);
- VPN networking services to support the interconnection of PINXs (i.e., related to the "b" type service entry points);
- inter-VPN services to provide co-operation between the VPN services of two networks (i.e., related to the "c" type service entry point);
- VPN management services to enable the service subscribers to control and manage their VPN resources and capabilities (i.e., related to the "d" type service entry point).

Standardization work is expected to build upon existing standards from both the private domain and the public domain wherever possible, and to follow existing work methodologies. This means, for example, where new services are concerned, stage 1, 2, and 3 specifications (together with associated PICS, PIXIT, and ATS in accordance with the policy of the relevant Technical Committee) are required for each new service. For existing services that need adaptation to the VPN environment, existing specifications (etc.) may need to be enhanced.

C.3.2.1 VPN end-user services ("a" type entry points)

The VPN Task Group recommended a work item (No. 1) to study VPN end-user service requirements at the a1, a2, a3 service entry points and to produce the relevant service descriptions. As a result of this recommendation a miscellaneous work item has been approved to study the requirements and define the scope of the relevant service descriptions.

The VPN Task Group recommended a work item (No. 2) to study the remote access service requirements at the a3 service entry point and to produce the relevant service description.

The VPN Task Group recommended a work item (No. 3) to study the requirements for changing between CN mode and public network mode at the a2 service entry point and to produce the relevant service description.

C.3.2.2 VPN networking services ("b" type entry points)

The VPN Task Group recommended a work item (No. 4) to study the VPN networking service requirements at the "b" service entry point.

C.3.2.3 inter-VPN services ("c" type entry point)

The VPN Task Group recommended a work item (No. 5) to study the functional requirements at the "c" service entry point. A work item to study the support of VPN services using IN techniques has been created.

C.3.2.4 VPN management services ("d" type entry point)

The VPN Task Group recommended a work item (No. 6) to study the VPN service management requirements at the "d" service entry point and to produce the relevant service description.

C.3.3 Network aspects

Network aspects include:

- emulation of gateway PINX functionality by the public network infrastructure (i.e., break-in/break-out);
- emulation of end-PINX functionality by the public network infrastructure (i.e., Integrated Services CenTreX (ISCTX);
- emulation of transit functionality by the public network infrastructure (i.e., Inter-Connecting Network (ICN));
- support of a CN spanning multiple public networks.

Figure C.1 illustrates the relationship between network aspects and the overview model of a CN.

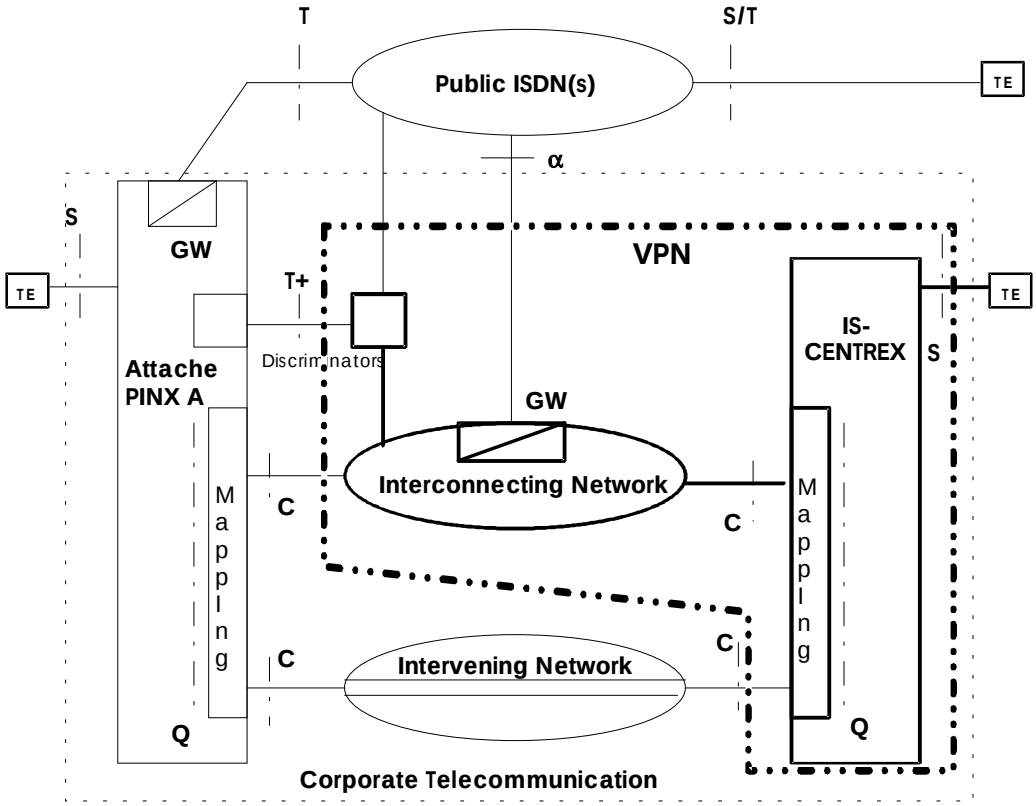

Figure C.1: Coverage of the term "VPN" (example only)

The involvement of two or more ICN providers in supporting one VPN requires standardization at their network-to-network boundaries, at the so-called N* reference point, see figure C.2.

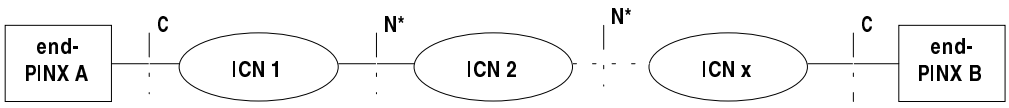

Figure C.2: Multiple ICNs

NOTE: It is stated in several places in the following subclauses that the VPN Task Group recommended a particular work item. Where this is the case, the reference to the work item in the report of the VPN Task Group is given in brackets e.g., (No. "x").

C.3.3.1 End-PINX functionality

No work on ISCTX has started.

C.3.3.2 Transit functionality

The architectural approach for accessing the transit functionality (ICN) has higher priority

The VPN Task Group recommended a work item (No. 7) to study the signalling protocols needed at the international interface to support VPN services across multiple public networks and for the interconnection of different VPN service providers. As a result of this recommendation, work is in progress to study the protocol enhancements needed to Signalling System No. 7 ISUP, and to define an extension to support VPN applications. The work is expected to be complete by the end of 1997.

The VPN Task Group recommended several work items:

- (No. 8) to specify the protocol for the provision of VPN services to end users ("a" service entry points);
- (No. 9) to identify and specify a suitable protocol to support VPN services to PBXs at the "b" type service entry points; and
- (No. 10) to identify and specify the requirements of an inter-PINX signalling protocol to support VPN services available at the "b" service entry point.

As a result of these recommendations, work is in progress to enhance the DSS1 Basic call (ETS 300 403) and Generic Functional Protocol (ETS 300 196) to support VPN applications. This compatible enhancement is known as "DSS1+". Completion of the work is presently scheduled for the end of 1997. However, it is not clear to what extent the 3rd recommendation (work item No. 10) is taken into account by this work.

C.4 CN mobility

C.4.1 Scope of sub-project

Two types of mobility are covered. The first type, in which the relationship between a terminal equipment and the network is dynamic, is Cordless Terminal Mobility (CTM). The second type of mobility, in which the relationship between the user and the terminal equipment is dynamic, is Private User Mobility (PUM).

CN mobility is the ability to provide a mobility service (CTM or PUM) to a user roaming in different networks. The sub-project covers work in 4 areas to support:

- cordless terminal mobility within a single CN (a private CTM user roaming in a single CN);
- cordless terminal mobility between a CN and a public network supporting CTM functions (a private CTM user roaming in a public network and a public CTM user roaming in a CN);
- private user mobility within a CN (a private PUM user roaming in a single CN); and
- Universal Personal Telecommunication (UPT) in CN (a public UPT user roaming in a CN).

The major technical issues presently being studied are listed in table 1 below. The table also shows the relationship between each of the technical issues and the 4 work areas listed above. The fact that a relation exists however should not be taken as an indication that work is presently being carried out in that area.

Table 1: Technical issues applicable to mobility work areas

Technical issue	CTM within a single CN	CTM spanning multiple networks	PUM	UPT in CN
Location handling	x	x	x	x
Mobile call handling	x	x	x	x
Authentication	x	x	x	x
Provision of supplementary services to mobile users	x	x	x	x
Handover	x	x		
Inter-network roaming		x		

Progress in each of the 4 work areas has been/is being achieved through a phase of pre-normative work followed by a phase of normative specification to deliver the necessary standards. The standards are expected to cover the architectural aspects and considerations arising out of CTM and PUM, and to provide a range of supplementary service specifications covering necessary signalling procedures and operations.

For each supplementary service the following specifications are required:

- stage 1 description;
- stage 2 description;
- stage 3 description (layer 3 protocol standards, QSIG) for inter-exchange signalling in PISNs (via a notional interface at the Q reference point); and
- stage 3 description (layer 3 protocol standard, DSS1) for PISN access (via an interface at the T reference point) to the public ISDN.

NOTE 1: No work on specific stage 3 descriptions (layer 3 protocol standards) for cordless terminal access (via an interface at the P reference point) to the private network is presently taking place.

NOTE 2: Stage 3 descriptions (layer 3 protocol standards) at the T reference point are required to permit inter-network roaming between a PISN and a public ISDN. Other standards for CTM in the public ISDN may be required, but these are outside the scope of the CN project.

NOTE 3: Each stage 3 description contains a Protocol Implementation Conformance Statement (PICS); however, there is presently no work in progress to produce conformance test specifications.

CN mobility topics as applicable to intra-CN related work items and to interworking related work items with public networks are jointly developed by STC-BTC1 (stages 1 & 2) and ECMA TC32 (stages 3). Mobility work items also fall within the co-ordination scope of the ETSI CTM project.

The content and status of the 4 work areas are described in the following subclauses.

C.4.2 Content and status of work items

C.4.2.1 General aspects

Pre-normative work identifying the general requirements for the 4 work areas has been completed. This includes an analysis of PISN basic call capabilities to support Cordless Terminal Mobility (CTM) and Private User Mobility (PUM).

Work on enhancing the reference configuration for Private Integrated Services Network Exchanges (PINX) is presently being carried out by ISO/IEC JTC1/SC6/WG6.

C.4.2.2 Cordless terminal mobility within a single CN

Technical work has been completed, and a first set of ETSs containing the stage 1, 2, and 3 descriptions is available. The following supplementary services have been defined:

- Location handling (location registration and transfer of service profile) - Stage 1 and 2 descriptions covering both aspects were published in April 1996. A stage 3 description, published at the same time, only covers location registration. No work has yet started on a stage 3 description for the transfer of service profile. A separate ETS specifying the information to be conveyed by the transfer of service profile supplementary service is expected to be published in 1997;

- Incoming call handling - stage 1, 2, and 3 descriptions were published in April 1996;

- Outgoing call handling - although the stage 1 and 2 descriptions were published in April 1996, the ETS for the stage 3 description is not expected to be published until 1997;

Standards containing stage 1, 2, and 3 descriptions for the Authentication supplementary service have been drafted and are expected to be published in 1997.

Standards containing stage 1 and 2 descriptions for the Handover supplementary service have been drafted and approved by TC-BTC. At present this service description is restricted to the case of handover between location areas controlled by a single PINX. These standards are expected to be published at the end of 1997. In the meantime, work is continuing to extend the service description (by means of a second edition) to cover the case of handover between PINXs within a single CN. No work on the stage 3 description is expected to take place before the 2nd editions have been completed.

C.4.2.3 Cordless terminal mobility between a CN and another network

A technical report on the principles of inter-network roaming (i.e., multiple network case) is being prepared. It is expected that this will be published in March 1997.

With the exception of the Handover supplementary service, drafting of 2nd editions of the service specifications listed in subclause C.4.2.2 above, to cover interworking for multi-network mobility, has commenced.

C.4.2.4 Private user mobility within a CN

ETR 280, examining the impact of PUM on the PISN, has been published in April 1996. Other, unpublished, pre-normative work on the general principles and security aspects of PUM, and on PUM's relationship to UPT has also been completed.

A first set of 4 standards has been TC-approved. These are the stage 1 and stage 2 descriptions covering registration procedures for incoming and outgoing calls, and call handling procedures. No work has yet begun on stage 3 descriptions.

C.4.2.5 Universal Personal Telecommunication (UPT) in CN

ETR 191 on the use of UPT "phase 1" in PISNs has been published in September 1995.

No further work has been done.

Annex D:
Testing for interoperability; technical analysis

This annex contains background material to support the analysis and recommendations made regarding the demonstration of interoperability as described in subclause 8.3.

D.1 Different technical approaches

Practically, different technical approaches can be taken in order to test interoperability. They generally aim at different objectives.

D.1.1 Compatibility testing

See figure D.1.

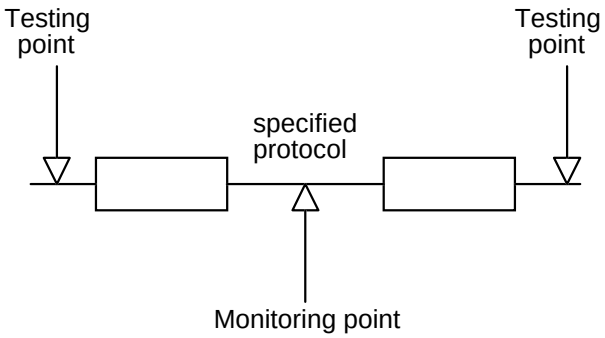

Figure D.1: Principle of compatibility testing

Compatibility testing is testing that two or more pieces of equipments or networks, connected together through a specified interface or protocol, are compatible and able to communicate according to specifications. Compatibility testing is in general concerned with checking the interoperability between two implementations of the same protocol. Depending on the context, examples of compatibility testing are:

- Box-to-box testing, e.g., QSIG interoperability between two PABXs;
- Node-to-node testing at the junction between (sub-)networks, e.g., testing the compatibility at the level of an NNI protocol.

D.1.2 Point-to-point testing

See figure D.2.

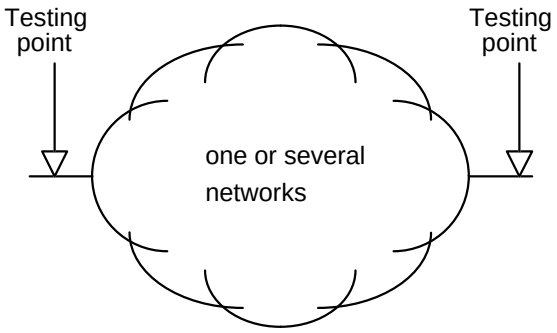

Figure D.2: Principle of point-to-point testing

Point-to-point (e.g., network-access-point to network-access-point, or end-to-end) testing is testing that one or more products, pieces of equipment, or networks, directly or indirectly connected, are able to provide a global end-to-end service at user access interfaces, as defined in specifications.

Although very similar technically, compatibility testing and point-to-point testing have different objectives. Whereas compatibility testing is concerned with checking the compatibility between two identified components and with identifying possible problems, point-to-point testing is concerned with globally testing a service.

EURESCOM has developed and used a "Network Integration Testing" methodology to perform, in particular (see ETR 193):

- node-to-node testing on SS No. 7 ISUP protocol; and
- end-to-end testing at S reference points.

D.1.3 Mapping or interworking testing

See figure D.3.

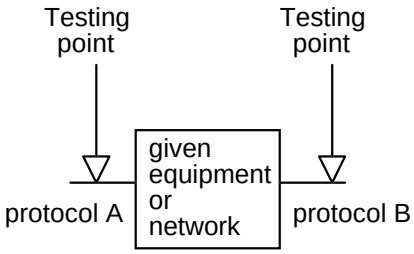

Figure D.3: Principle of mapping testing

Mapping (i.e., protocol mapping) or interworking testing is the testing of mapping between protocols. Example are:

- mapping of signalling protocols between access interfaces and trunk interfaces (e.g. DSS1 to ISUP);
- interworking functions, as between GSM and ISDN services.

D.2 Proformas for documenting optional functions implemented

EURESCOM project P.412 has prepared, for the public ISDN, proformas allowing suppliers to document which services and which options have been implemented in a piece of equipment, a network or a part of a network. Similar proformas could be developed for CN; for example:

Bearer service = speech

Item	Does the network support...	Status M/O	Support Y/N
1	bearer service speech?	M	
2	telephony 3,1 kHz teleservice?	M	

Bearer service = Unrestricted digital information

Item	Does the network support...	Status M/O	Support Y/N
1	bearer service unrestricted digital information?	M	
2	unrestricted digital information?	O	
3	teletex basic and mixed mode terminals?	O	
4	teletex basic and processable mode terminals?	O	
5	teletex basic terminals?	O	
6	international videotex interworking?	O	
7	telex service?	O	
8	message handling systems?	O	
9	OSI applications?	O	
10	videotelephony, high layer compatibility?	O	
11	terminal adapters V.110/X.30 for synchronous traffic with rate adaptation information coded in Bearer capability information element?	O	
12	terminal adapters V.110/X.30 for synchronous traffic with rate adaptation information coded in Low layer information element?	O	
13	terminal adapters V.110/X.30 for asynchronous traffic with rate adaptation information coded in Bearer capability information element?	O	
14	terminal adapters V.110/X.30 for asynchronous traffic with rate adaptation information coded in Low layer information element?	O	

Bearer service = 3,1 kHz audio

Item	Does the network support...	Status M/O	Support Y/N
1	bearer service 3,1 kHz audio?	M	
2	teleservice telefax group 2/3?	O	
3	low layer compatibility = voice band data via modem	O	

.... tables for individual supplementary services:

Item	Does the network support...	Status M/O	Support Y/N
1	CFU supported?	O	
2	Notification of call diversion to calling party?	O	
3	Release of served user name to diverted-to user?	O	
Please specify any non-standard deviations, e.g., activation procedure:			

D.3 Test Purposes for "Access point to Access point" service testing

D.3.1 Example of a test purpose

The table below contains a "simple" test purpose, again drawn from the EURESCOM project P.412:

211101	**Ref. to ETS....**	**Other relevant reference**
TSS reference:.../Supplementary_services/Speech/CFU/TC21101		
Selection criteria	The user A and the user C are in network N1. The user B is in network N2 and is provided with CFU ("calling user is notified of call diversion" = Yes, with diverted-to number, "diverting number is released to the diverted-to user" = Yes).	
Test Purpose	Ensure that when user A calls user B, the call is forwarded to user C, user A is notified of call diversion and informed of the diverted-to number (user C has presentation allowed - no COLR) and user C is informed of the forwarding number (users B has presentation allowed).	

Annex E:
Standardization at the S reference point

This annex identifies some issues concerning standardization at the S reference point:

1) What is the objective of standardization at the S reference point?

2) Which service specifications should form the basis of protocol development at the S reference point?

   - Is the task of standardization at S just a case of taking the existing DSS1 standards and extending their scope?

   - From the formal point of view, protocols at the S reference point (SSIG) are the stage 3 descriptions of the basic and supplementary services standardized for PISNs by ECMA TC32 (and more recently, ISO/IEC JTC1). Where the same service is defined for both the PISN and the public ISDN environments would the protocol at S (SSIG) and the protocol at S/T or T (DSS1) be the same? If not, what would be the technical differences (both at the protocol (i.e., stage 3) level, and at the service description (i.e., stage 1) level)?

   - One source has expressed the view that users want to be able to use the same type of ISDN terminals for both public ISDN and Centrex applications. At the same time, this source states that protocols for Centrex should be based on PISN service specifications. What are the implications of these apparently contradictory statements?

3) Which services have to be standardized? -- MoU phase 1 and 2, Common minimum set, etc.?

   - If the objective is to enable Euro-ISDN terminals to be used for "behind-PABX" and Centrex applications, then what is the definition of a Euro-ISDN terminal? Is it one that supports some or all of the standards (essentially, ISDN MoU phase 1 & 2) identified by IMIMG and IMCC as "frozen" in June 1992? Or is it one that supports the mandatory services (phase 1) specified in the ISDN MoU?

4) The following tasks may be necessary to achieve standards at the S reference point:

   - using the text of DSS1 standards as a starting point, generate new stage 3 standards for SSIG; alternatively, modify the scope statements of the existing DSS1 standards to make the protocol applicable at the S reference point;

   - add a new clause or generate a new standard (called mapping/interworking standard in the PT85 work) covering interworking between the protocol at S and the protocols at T and at Q;

   - add a new clause or generate a new document (called behaviour guidelines in the PT85 work) to specify how an implementation should "behave" (e.g., with respect to processing of addressing information, generation of CLI information, or processing of videotelephony calls) over and above the behaviour already standardized as "Protocol Control" and "Call Control".

5) A suggestion has been made that there should be harmonization of protocols at the S reference point with the protocols at the coincident S/T and T reference points, and that this should be described within a single document - as has been done for layers 1 and 2. Is this a good way to proceed?

   - Previous work on the Generic Keypad protocol highlighted some areas of incompatibility between the public and private standards that would have rendered the resultant standard not backwards compatible with one of its predecessors; the work failed as a result.

Annex F: Bibliography

This annex contains bibliography of documents (additional to those referred in clause 2) useful to further understand CN standardization issues. Those documents that are especially useful are marked with an asterisk (*).

- ETS 300 403-3 (1996): "Integrated Services Digital Network (ISDN); Digital Subscriber Signalling System No. one (DSS1) protocol; Signalling network layer for circuit-mode basic call control; Part 3: Protocol Implementation Conformance Statement (PICS) proforma specification".

- ETSI/IMCC (92) 1: "ISDN (standards) Management & Co-ordination (IMCC); Status of Bons de Commande 74 - 77 standards for private telecommunications networks (PTN)".

- ETSI/IMCC (93) 2: "ISDN (standards) Management & Co-ordination Committee (IMCC) Report of the 6th Meeting held in Sophia Antipolis 30th August - 1st September 1993".

- ETSI/MTS (95) 10: "The future in ETSI of Quality of standards-making, Validation and Testing".

- ETSI/TA20 (94) 50: "Europe's way to the information society: an action plan".

- ETSI/TC-BT (92) 7: "Technical Committee Business Telecommunications - Report of TC-BT meeting No. 11 Aarhus, 25-27 November 1992".

- TCR-TR 006 (1996): "Methods for Testing and Specification (MTS); ETSI and certification in telecommunications; Overview of outstanding issues and some recommendations".

-* TCR-TR 033 (1995): "Business TeleCommunication (BTC); Private Telecommunication Network (PTN); Integrated scenario for business communications".

-* TCR-TR 034 (1995): "Business TeleCommunications (BTC); Virtual Private Networking (VPN); Services and networking aspects; Standardization requirements and work items" Edition 2.

-* TCR-TR 041 (1995): "Business TeleCommunications (BTC); Corporate Telecommunication Networks (CN); Project plan" Edition 2.

History

Document history			
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