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Information technology — Telecommunications and information exchange between systems — Interoperation of PISNs with IP networks

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Foreword

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— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

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Attention is drawn to the possibility that some of the elements of this Technical Report may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC TR 21890, which is Technical Report of type 3, was prepared by ECMA (as Technical Report ECMA TR/81) and was adopted, under a special "fast-track procedure", by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

Introduction

This Technical Report investigates the interoperability of Private Integrated Services Networks (PISNs) and Internet Protocol (IP) networks within the context of Corporate Telecommunication Networks. The purpose is to identify possible scenarios for interoperation, problems that will have to be solved if particular scenarios are to be pursued further, and possible future standardization activities in this area. It forms the foundation for further work in ECMA on this subject, including the production of Standards where found to be required.

This Technical Report is based upon the practical experience of ECMA member companies and the results of their active and continuous participation in the work of ISO/IEC JTC1, ITU-T, ETSI, IETF and other international and national standardization bodies. It represents a pragmatic and widely based consensus.

Information technology - Telecommunications and information exchange between systems - Interoperation of PISNs with IP Networks

1 Scope

The purpose of this Technical Report is to investigate the interoperability of Private Integrated Services Networks (PISNs) and Internet Protocol (IP) networks, with a view to identifying possible scenarios for interoperation, problems that will have to be solved if particular scenarios are to be pursued further, and possible future standardization activities in this area. In particular, the following aspects of interoperability are investigated:

- the interworking of PISNs and IP networks via a gateway;
- the connection of PISN components via IP networks.

For each of the above, aspects considered include architecture, addressing (including use of IP addressing), services, protocols, security, quality of service and mobility. This is conducted within the context of leading standards for voice and multimedia communication over IP networks, including ITU-T recommendation H.323, IETF Session Initiation Protocol (SIP) and ITU-T recommendation H.248.

Possible future standardization activities resulting from this Technical Report can include work items relating to IP networks and work items relating to PISNs, as well as work items concerned specifically with interoperability.

The dominant traffic in PISNs is voice, and therefore this Technical Report focuses on interoperability considerations for voice traffic. However, many of the standards that support voice in an IP network are also applicable to multi-media traffic (e.g., voice, video and data). Although in many respects similar to voice, fax traffic has slightly different requirements and is not explicitly considered in this Technical Report. It could be the subject of further study.

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ISO/IEC 11579-1, *Information technology - Telecommunications and information exchange between systems - Private Integrated Services Network - Part 1: Reference configuration for PISN exchanges (PINX)*

ISO/IEC 11582, *Information technology - Telecommunications and information exchange between systems - Private Integrated Services Network - Generic functional protocol for the support of supplementary services - Inter-exchange signalling procedures and protocol*

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ISO/IEC 13873, *Information technology - Telecommunications and information exchange between systems - Private Integrated Services Network - Inter-exchange signalling protocol - Call diversion supplementary services*

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ISO/IEC 15506, *Information technology - Telecommunications and information exchange between systems - Private Integrated Services Network (PISN) - Inter-Exchange Signalling Protocol - Message Waiting Indication Supplementary Service*

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ITU-T Rec. H.245, *Control protocol for multimedia communication*

ITU-T Rec. H.248, *Gateway control protocol*

ITU-T Rec. H.261, *Video codec for audiovisual services at p ×64 kbits*

ITU-T Rec. H.320, *Narrow-band visual telephone systems and terminal equipment*

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ITU-T Rec. H.450.1, *Generic functional protocol for the support of supplementary services in H.323*

ITU-T Rec. H.450.2, *Call transfer supplementary service for H.323*

ITU-T Rec. H.450.3, *Call diversion supplementary service for H.323*

ITU-T Rec. H.450.4, *Call hold supplementary service for H.323*

ITU-T Rec. H.450.5, *Call park and call pickup supplementary services for H.323*

ITU-T Rec. H.450.6, *Call waiting supplementary service for H.323*

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ITU-T Rec. H.450.8, *Name identification supplementary service for H.323*

ITU-T Rec. H.450.9, *(draft) Call completion supplementary services for H.323*

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ITU-T Rec. Q.931, *ISDN user-network interface layer 3 specification for basic call control*

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IETF RFC 2327, *SDP: Session Description Protocol*

IETF RFC 2401, *Security Architecture for the Internet Protocol*

IETF RFC 2402, *IP Authentication Header*

IETF RFC 2406, *IP Encapsulating Security Payload (ESP)*

IETF RFC 2407, *The Internet IP Security Domain of Interpretation for ISAKMP*

IETF RFC 2408, *Internet Security Association and Key Management Protocol (ISAKMP)*

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3 Terms and definitions

For the purposes of this Technical Report the following definitions apply.

3.1 Corporate telecommunication Network (CN) : Sets of equipment (Customer Premises Equipment and/or Customer Premises Networks) that are located at geographically dispersed locations and are interconnected to provide telecommunication services to a defined group of users.

NOTE - A CN can comprise a PISN, a private IP network (intranet), or a combination of the two.

3.2 Internet : A public IP network.

3.3 Intranet : A private IP network.

3.4 Internet Protocol (IP) : The protocol specified in RFC 791 (IP version 4) or in RFC 2460 (IP version 6).

3.5 IP network : A public or private network offering connectionless packet-mode services based on the Internet Protocol (IP) as the network layer protocol.

NOTE - The Internet is the prime example of a public IP network.

3.6 Private Integrated Services Network (PISN) : A private SCN.

3.7 Private Integrated services Network eXchange (PINX) : See ISO/IEC 11579-1.

3.8 Switched Circuit Network (SCN) : A public or private network offering connection-oriented circuit-mode telecommunication services.

3.9 Tunnelling : A means of transporting protocol information between two entities that are interconnected by a network, without the need for that interconnecting network to comprehend the transported protocol information.

4 Acronyms

AC	Admission Control (functional entity)
AH	Authentication Header
BICC	Bearer-Independent Call Control
CC	Call Control (functional grouping)
CLIP	Calling Line Identification Presentation
CLIR	Calling/connected Line Identification Restriction
CN	Corporate telecommunication Network
COLP	Connected Line identification Presentation
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
ESP	Encapsulating Security Payload
GK	Gatekeeper
GW	Gateway

HLS	Higher Layer Signalling (functional entity)
HTTP	Hyper-Text Transfer Protocol
ICC	Inter-PINX Connection Control (functional grouping)
ICN	InterConnecting Network
IP	Internet Protocol
IPC	Inter-PINX Connection
IPL	Inter-PINX Link
IR	Identity resolution (functional entity)
ISAKMP	Internet Security Association and Key Management Protocol
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part (of SS7)
IVN	InterVening Network
IW	InterWorking (functional entity)
LAN	Local Area Network
LDAP	Lightweight Directory Access Protocol
LLS	Lower Layer Signalling (functional entity)
MG	Media Gateway
MGC	Media Gateway Controller
MP	Mapping (functional grouping)
MPP	Media processing and packetization (functional entity)
MTP	Message Transfer Part (of SS7)
PINX	Private Integrated services Network eXchange
PISN	Private Integrated Services Network
PNP	Private Numbering Plan
QoS	Quality of Service
RAS	Registration, Admission and Status
RC	Resource Control (functional entity)
RC-P	RC-Proxy (functional entity)
RFC	Request For Comment
RGR	Registrar (functional entity)
RGT	Registrant (functional entity)
RTCP	Real-time Transport Control Protocol
RTP	Real-time Transport Protocol
SC	Session Control (functional entity)
SCN	Switched Circuit Network
SC-P	SC-Proxy (functional entity)
SC-R	SC-Redirect (functional entity)
SCTP	Stream Control Transmission Protocol
SG	Signalling Gateway

SIP	Session Initiation Protocol
SSL	Session Security Layer
SM	Scenario Management (functional grouping)
SS7	Signalling System number 7
SW	Switching (functional grouping)
TCP	Transmission Control Protocol
TDM	Time Division Multiplexing
TIA	Telecommunications Industry Association
TLS	Transport Layer Security
TRIP	Telephony Routing Information Protocol
UDP	User Datagram Protocol
URL	Universal Resource Locator
VoIP	Voice over IP
VPN	Virtual Private Network

5 Introduction

5.1 Background

Private Integrated Services Networks (PISNs), based on 64kbit/s-based Time Division Multiplexing (TDM) techniques, have for many years been the basis of corporate voice communications, and additionally have supported other services such as facsimile, video and data (circuit-switched and packet-switched). The technology is similar to that of public Integrated Services Digital Networks (ISDNs). More recently, the connection of virtually every desktop to a Local Area Network (LAN), the growth of the Internet and the building of "intranets" and "extranets" have led to the desire to use these data networks also for voice communications. There are a number of motives behind this, including cost savings (by the use of common wiring and equipment) and the potential for applications that exploit the integration of voice, data and other media to the benefit of the business.

The network layer protocol is of great importance in data networks, since it has to support a wide range of applications and the higher layer protocols that they employ, whilst at the same time being able to operate over a wide variety of infrastructures. Because of the growth of the Internet, the Internet Protocol (IP) has become the dominant network layer protocol. Although at present version 4 of IP (IPv4, RFC 791) is almost universal, lack of address space and other considerations are creating a lot of interest in version 6 (IPv6, RFC 2460). Except where otherwise stated, the term IP in this Technical Report refers to either IPv4 or IPv6.

To carry voice over data networks, it has to be carried over IP, and hence the term "Voice over IP" (VoIP) has come into being. Voice over IP can be used in a number of ways, including:

- end-to-end between terminal equipments attached to IP networks;
- between a terminal equipment attached to an IP network and a point of interworking with a PISN or other network;
- between two networks, in particular between two PISNs or between a PISN and another network;
- between two parts of the same network, in particular between two Private Integrated Service Network eXchanges (PINXs) belonging to the same PISN; or
- between a terminal equipment and its point of attachment to its serving network, in particular between a terminal equipment and its serving PINX.

From this list it can be seen that PISNs can interoperate with IP networks in a number of different ways, and this is the subject of this Technical Report. The Technical Report focuses chiefly on voice, this being the service most often provided by a PISN. In particular, this means that packet mode aspects of PISNs are not considered.

Figure 1 shows an example illustrating these different means of voice communication through an IP network. The IP terminal equipments have direct access to the IP network, telephones 1 and 2 have access to the IP network through a gateway (labelled as gateway type 1) and PINXs A and B have access to the IP network through a gateway (labelled as gateway type 2). All these entities can communicate with each other through the IP network using the respective gateways.

In addition, PINX A and PINX B may be able to communicate with each other via the IP network using gateways that provide special support for inter-PINX communication. For this purpose PINX A and PINX B are shown as being attached to the IP network also through gateways labelled as gateway type 3.

Finally, telephones 3 and 4 are shown as being served by PINX B, access being achieved via the IP network using gateways (labelled as gateway type 4 on the telephone side of the IP network and gateway type 5 on the PINX side of the IP network). These telephones cannot make and receive calls directly through the IP network to other destinations (e.g., IP terminal equipments) but make and receive all calls via PINX B.

NOTE - Although these different gateway types have functional differences, there may also be substantial similarities in practice between some of these types. Also a physical realisation of a gateway might incorporate more than one of these gateway types.

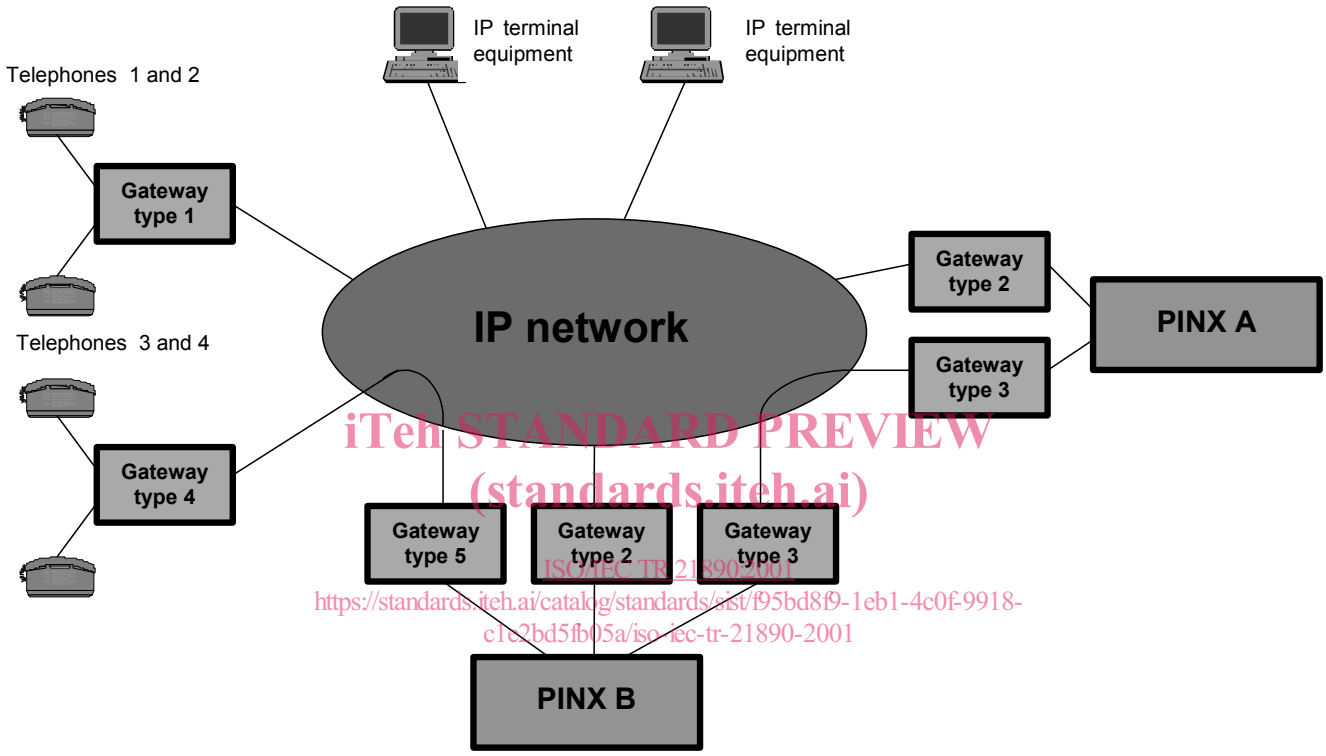

Figure 1 – Example of voice communication through an IP network

Gateway type 2 can be used for interworking between PISNs and IP networks, which is considered in clause 8. Gateway type 3 can be used for interconnecting PISNs or PISN components via IP networks, which is considered in clause 9. Gateway types 1, 2, 4 and 5 can be used for connection of (remote) telephones to a PINX via an IP network, which is considered in clause 10.

5.2 Types of network

An IP network operates in packet mode, since information is sent in packets, when information is available, rather than as a continuous stream. Each packet is routed individually, rather than being switched in accordance with a pre-established connection. This makes an IP network a connectionless packet network.

This contrasts with a PISN, where information is transmitted along the path of a pre-established connection (connection-oriented). A PISN can operate in circuit mode, where information is transmitted as a continuous stream of bits, or in packet mode, where information is sent in packets. In the case of voice, circuit mode is used, and therefore this Technical Report regards a PISN as a private connection-oriented circuit mode network.

Similar considerations apply to public ISDNs, which can be regarded as public connection-oriented circuit mode networks. Although the focus of this Technical Report is on PISNs interoperating with IP networks, public ISDNs have to be considered in the overall picture.

An IP network can provide services to a limited set of users (in a corporation), and therefore can be considered to be a private IP network (or intranet). Alternatively an IP network can provide services to the general public (as is the case with the existing Internet), in which case it can be considered to be a public IP network (or Internet). The term “extranet” is often used to describe an intranet that is spread over multiple administrative domains. “Extranets” are not considered further in this Technical Report.

A Corporate telecommunication Network (CN) can comprise a PISN, an intranet, or a combination of the two.

Based on these considerations, this Technical Report uses the following terminology:

- switched circuit network (SCN): a PISN or public ISDN offering connection-oriented circuit-mode services;
- IP network: a public or private network offering connectionless packet-mode services based on IP as the network layer protocol.

Therefore in examining the interoperability of PISNs and IP networks, this Technical Report focuses on the interoperation of SCNs and IP networks, with particular emphasis on Corporate telecommunication Networks.

5.3 Arrangements for interworking of SCNs and IP networks

Figure 2 illustrates possible interworking between the following types of network:

- private switched circuit network (PISN);
- public switched circuit network (public ISDN);
- private IP network (intranet);
- public IP network (Internet).

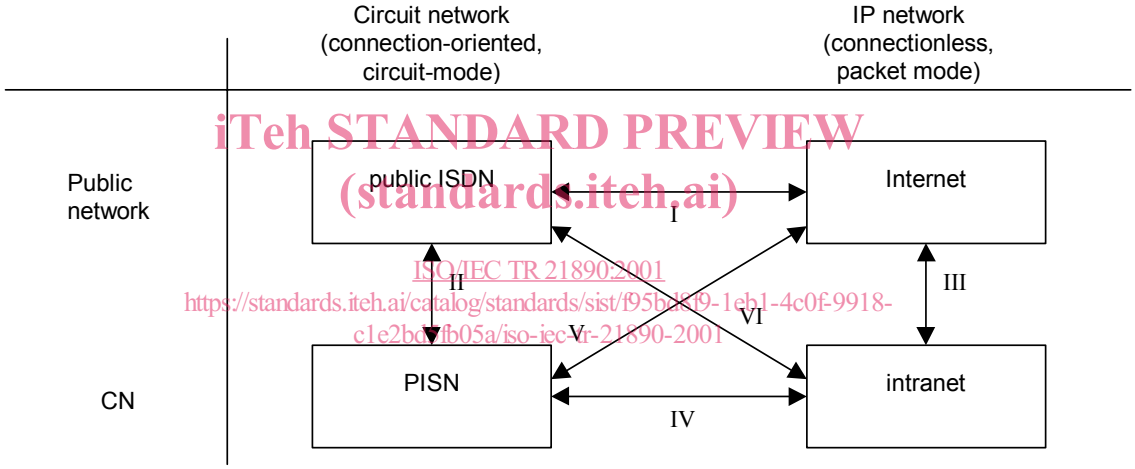

Figure 2 – Interworking arrangements

Arrangements I to VI are listed in table 1, along with their coverage in standards bodies and their security implications.

Table 1 – Interworking arrangements

No.	Description	Coverage in standards bodies	Security implications
I	public ISDN / Internet	No CN impact, outside the scope of this Technical Report and covered by ETSI project TIPHON (see 7.5).	No CN impact, outside the scope of this Technical Report.
II	public ISDN / PISN	SCNs only, outside the scope of this Technical Report.	SCNs only, outside the scope of this Technical Report.
III	Internet / intranet	IP networks only, outside the scope of this Technical Report and covered by IETF.	IP networks only, typically covered by firewalls. Outside the scope of this Technical Report and covered by IETF.
IV	PISN / intranet	Covered by this Technical Report, see clause 8.	Possible security impact leading to the employment of some firewall functions in addition to gateway capability – the two functions may be combined or separate.