R E V I E W S

Miroslav Voznak *

# EXTENT OF SERVICES SUPPORTED BY Q-SIGNALING OVER IP

*QSIG is a signaling protocol used for interconnection of various telecommunication systems in corporate networks. These networks are composed of homogeneous or heterogeneous elements. Basic procedures of connection and supplementary services are transferred through messages, which are defined in recommendations ETSI or ISO. QSIG can be used for transport proprietary signaling between the same PBXs and is supported in voice gateway of solution of Voice over IP too and environment of IP network is often chosen for interconnection between PBXs. The main aim of this paper is to acquaint specialists with the result of the QSIG compatibility test between Siemens and Cisco. Siemens produces one of the most used telecommunication systems in the Czech republic and Cisco systems routers are the most used in IP solutions. In order to provide all supplementary services in telecommunication, Siemens developed a new protocol, called CorNet-NQ, which is a superset of QSIG and uses messages tunnelling through QSIG. For realization of this test the QSIG version PSS1V2 in agreement with the ISO standards was used. [1]*

## 1. Introduction

QSIG is a signaling protocol for controlling the establishment, maintenance and clearing of calls between PINXs, nodal entity known as Private Integrated services Network eXchange. It provides an extremely powerful method of connecting PINX equipment in a corporate network. QSIG is not a proprietary standard. It is an open, international standard and is supported by the world's leading PBX suppliers. Twelve of the world's leading PBX manufacturers signed a Memorandum of Understanding (MoU) concerning the development and support of QSIG. The MoU, which came into effect on 1st February 1994, commits the signatories to facilitate the performance of interoperability tests and to:

- incorporate a Primary Rate interface (as defined in ETS 300 011) into its products,
- support a Basic Call (as defined in ETS 300 172),
- implement the generic procedures (as defined in ETS 300 239),
- implement QSIG supplementary services as far as each signatory considers to be economically viable,
- and participate in interoperability testing with the other signatories.

QSIG standards are developed within ECMA in Technical Committee 32 (TC32) for Communications, networks and systems interconnection. TC32 began to work on QSIG in 1988 and most of these standards were published also as ISO/IEC International Standards, endorsed by ETSI as European Standards and implemented by all major PBX vendors. [2]

## 2. QSIG protocol stack

QSIG standards specify a signaling system at the "Q" reference point, which is primarily intended for use on a common channel;

| Layer | Standards | | | Description |
|---|---|---|---|---|
| Layer 4-7 | Application mechanism | | | End to End protocol network transparent |
| Layer 3 | Standards depend on the value of supplementary services | | | QSIG procedures for supplementary services |
| | ISO/IEC 11582, ETS300 239, ECMA165 | | | QSIG Generic Functional Procedures |
| | ISO/IEC 11574/11572, ETS300 171/172, ECMA142/143 | | | QSIG Basic Call |
| Layer 2 | ECMA141, ETS300 402 | | | Interface-dependent protocols |
| Layer 1 | Basic Access (BRA) ETS300 011 I.430 | Primary Access (PRA) ETS300 012 I.431 | | |
| Medium | Copper Wire | Copper Wire | Optical fibre | |

*Figure 1: Reference model QSIG*

* **Miroslav Voznak**
Technical University of Ostrava, Faculty of Electrical Engineering and Computer Science, Department of Electronics and Telecommunications,
Tel: +420 596991699, E-mail: miroslav.voznak@vsb.cz

e.g. G.703 interface. Within the public ISDN the two end PINXs are connected through two reference points using different ISDN protocols, namely DSS1 at the "T" reference point and ISUP within the public ISDN at the "N" reference point. For private ISDNs, only one protocol is necessary as the QSIG protocols have sufficient functionality to be used both within the network at transit nodes and on the outside at access nodes.

The architecture of QSIG signaling protocol agrees with the architecture RM OSI, see Figure 1.

The standard for Basic Call is ECMA 143 (ISO/IEC 11572), QSIG generic support for supplementary services is defined in ECMA-165 as a toolkit on which signaling for support of supplementary services can easily be built (ISO/IEC 11582). The QSIG protocol stack is identical in structure to the DSS1 protocol stack. Both follow the ISO reference model. Both can have an identical layer 1 and layer 2 (LAPD). However, at layer 3 QSIG and DSS1 differ.

In the last years significant part of work inside TC32 is concerned with the interoperation of Private Integrated Services Networks (PISN) with IP Networks, in particular with the two following aspects:
- Interworking of PISNs and IP networks via Gateway, primarily between QSIG and H.323 and between QSIG and SIP,
- Connection of PISN components via IP network infrastructures (i.e. QSIG tunnelling).
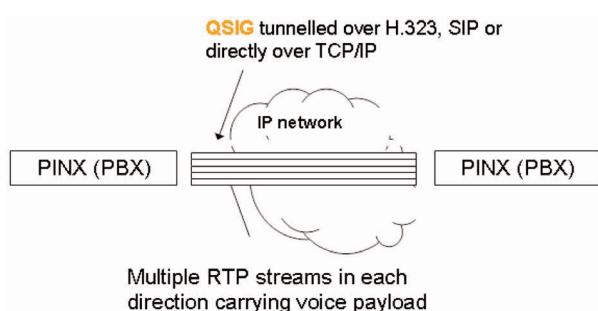


Figure 2 : Tunnelling QSIG over IP network.

Inside the TC32 a new Task Group TG-17 was founded, known as TC32 – TG17, for standardization in the area of IP-based multimedia communications. This group considers possible future work in the area of NGN (Next Generation Networks), where close cooperation with ETSI is anticipated.

New ECMA standards allow tunnelling QSIG over IP network, see Figure 2, these standards are listed below.

Interworking between QSIG and H.323:
- *ECMA-332 – basic call*
- *ECMA-307 – generic support for supplementary services*
- *ECMA-308 – call transfer supplementary services*

- *ECMA-309 – call diversion supplementary services*
- *ECMA-326 – call completion supplementary services*

Interworking between QSIG and SIP:
- *ECMA-339 – basic call*
- *work in progress on call transfer and call diversion services*

Tunnelling of QSIG over IP (for PBX interconnection):
- *ECMA-333 – tunnelling of QSIG over H.323*
- *ECMA-336 – tunnelling of QSIG directly over TCP/IP*
- *work in progress on tunnelling QSIG over SIP*

Figure 3 shows that for private ISDNs, the QSIG protocols have sufficient functionality to be used both within the network at transit nodes and on the outside at access nodes. Hence QSIG is used between all three PINXs. The "Q" reference point is the logical signaling point between two PINXs. The physical connection to the PINXs is made at the "C" reference point. The Intervening Network (IVN) can be either dedicated channels (analogue or digital) or switched connections (for Virtual Private Networks).
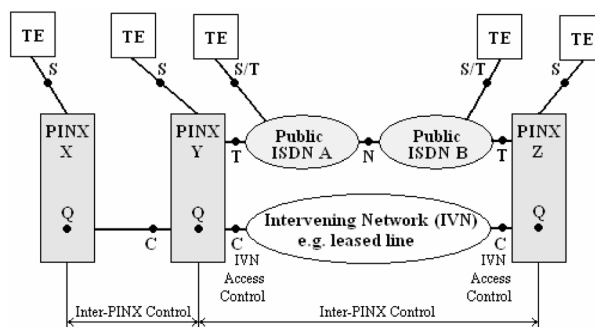


Figure 3: Reference model extended for corporate networks

## 3. Conditions of QSIG test interoperability

User signaling services can be divided into two groups:
- *BASIC CALL* – to transfer the control information required for the set-up, monitoring and release of connection and the identification of a subscriber's number,
- *SUPPLEMENTARY SERVICES* – to exchange signaling information for the control of the supplementary services and additional network features (ANFs)

*System components used in test*                      *Tab. 1*

| PBX model | Siemens HiPath4000 |
| --- | --- |
| PBX Release | Version 1-09 |
| Signaling | QSIG (PSS1V2/ISO) |
| Interface | ISDN BRI |
| Voice gateway | Cisco 1751-V |
| Gateway release | IOSTM 12.3(6a) |
| VoX protocol | ITU-T H.323 |

In this QSIG test interoperability individual supplementary services were tested and signalling messages were traced between interconnected equipment in all signalling path. [3], [4], [5], [6].
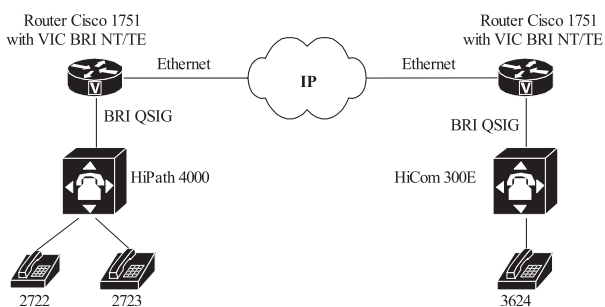
*Test configuration*



*Figure 4: Used model of tested network.*

### 3.1 Configuration of the voice gateway

*Set up Notes*
The Cisco 1751-V gateway with BRI-ISDN supports protocol QSIG, when the value of Switch-type parameter is set to *basic-qsig*. The network side on the BRI is set by the following commands:
- isdn layer1-emulate network,
- isdn protocol-emulate network.

Significant part of configuration in Cisco voice gateway is shown below as an example.

```
/* for interface BRI                      /* for outgoing and incoming route

interface BRI0/0                          dial-peer voice 2 pots
 no ip address                            destination-pattern ....
 isdn switch-type basic-qsig              direct-inward-dial
 isdn overlap-receiving T302 5000         port 0/0
 isdn protocol-emulate network            !
 isdn layer1-emulate network              dial-peer voice 11 voip
 isdn incoming-voice voice                destination-pattern 36..
 isdn static-tei 0                        session target
 isdn timeout-signaling                   ipv4:195.113.113.156
!                                         codec g711alaw
voice-port 0/0,
 compand-type a-law
 cptone CZ
 bearer-cap 3100Hz
!
```

### 3.2 Configuration of the PBX

*Set up Notes*
The Siemens HiPath 4000 supports the protocol QSIG when the value of parameter Protvar in TDCSU command is set to *PSS1V2*, and the user side on the BRI is set by the following parameters:
- *MASTER = N*,
- *SMD = N*.

A significant part of configuration in Siemens HiPath 4000 is shown below as an example.

```
                   /* TDCSU – command for trunk configuration

+------------------------ DIGITAL TRUNK (FORMAT=L) ------------------------+
| DEV     = S0CONN        PEN      = 1-01-103-1   TGRP     = 157           |
|-------------------------------------------------------------------------|
| PROTVAR = PSS1V2        INS      = Y            SRCHMODE = CIR           |
| COTNO   = 11            COPNO    = 10           DPLN     = 0             |
| ITR     = 0             COS      = 3            LCOSV    = 1             |
| LCOSD   = 1             CCT      = CISCO 157    DESTNO   = 157           |
| SEGMENT = 8             DEDSCC   =              DEDSVC   = NONE          |
| FACILITY =              DITIDX   =              SRTIDX   =               |
| TRTBL   = GDTR          SIDANI   = N            ATNTYP   = TIE           |
| CBMATTR = NONE          NWMUXTIM = 10           TCHARG   = N             |
| SUPPRESS = 0            DGTPR    =              CHIMAP   = N             |
| ISDNIP  =               ISDNNP   =                                      |
| PNPL2P  =               PNPL1P   =              PNPAC    =               |
| TRACOUNT = 31           SATCOUNT = MANY         NNO      =               |
| ALARMNO = 0             FIDX     = 1            CARRIER  = 1             |
| ZONE    = EMPTY         COTX     = 11           FWDX     = 1             |
| DOMTYPE =               DOMAINNO =              TPROFNO  =               |
| INIGHT  =                                       CCHDL    =               |
| UUSCCX  = 16            UUSCCY   = 8            FNIDX    = 1             |
| CLASSMRK = EC      & G711    & G729OPT          SRCGRP   =               |
| TCCID   =                                                               |
|-------------------------------------------------------------------------|
| MASTER  = N             SMD      = N            CNTRNR   = 0             |
| BCNEG   = Y                                                             |
+-------------------------------------------------------------------------+

    /* next commands RICHT, LDAT and WABE are needed, closed numbering scheme was used
                            in configuration
```

### 3.3 Decoding of QSIG

To decode the QSIG messages, SW application the WinVisu was used. It supports CORNET-NQ decoding protocol too and all the contents of signaling are in detail displayed in accordance with the recommendation of the chosen protocol, see Figure 5.
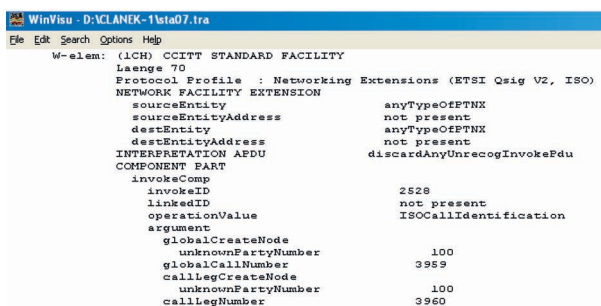


```
WinVisu - D:\CLANEK-1\sta07.tra
File  Edit  Search  Options  Help
     W-elem: (1CH) CCITT STANDARD FACILITY
             Laenge 70
             Protocol Profile  : Networking Extensions (ETSI Qsig V2, ISO)
             NETWORK FACILITY EXTENSION
                sourceEntity              anyTypeOfPTNX
                sourceEntityAddress       not present
                destEntity                anyTypeOfPTNX
                destEntityAddress         not present
             INTERPRETATION APDU          discardAnyUnrecogInvokePdu
             COMPONENT PART
                invokeComp
                   invokeID               2528
                   linkedID               not present
                   operationValue         ISOCallIdentification
                   argument
                      globalCreateNode
                         unknownPartyNumber       100
                      globalCallNumber            3959
                      callLegCreateNode
                         unknownPartyNumber       100
                      callLegNumber               3960
```

*Fig. 5. Screen of WinVisu window*

## 4 Test result

In the table below, the tested supplementary services are listed including the results related to each of these services.

Only one service (of all 22 supplementary services), Call Completion Busy Subscriber – CCBS did not work properly because the SETUP message was not transferred correctly through the IP network.

**Information element in SETUP message with CCBS**
```
W-elem: (1CH) CCITT STANDARD FACILITY
   Laenge 48
   Protocol Profile : Networking Extensions (ETSI Qsig V2, ISO)
   NETWORK FACILITY EXTENSION
      sourceEntity            endPTNX
      sourceEntityAddress           not present
      destEntity              endPTNX
      destEntityAddress             not present
   INTERPRETATION APDU     rejectAnyUnrecInvokePdu
   COMPONENT PART
      invokeComp
         invokeID            23280
         linkedID                  not present
         operationValue      ISOCcbsRequest
         argument
            numberA
               presAllowedNumber
                  unknownPartyNumber    2722
            numberB
               unknownPartyNumber       3624
            service          0x04 0x03 0x80 0x90 0xa3
                             0x7d 0x02 0x91 0x81
```

Table of tested supplementary services                Table 1

| Description | | Support |
|---|---|---|
| Call Completion | Busy subscriber – CCBS | NOK |
| | No Reply – CCNR | OK |
| Call Forwarding | Busy subscriber – CFBS | OK |
| | No Reply – CFNR | OK |
| | Unconditional – CFU | OK |
| Call Intrusion – CI | | OK |
| Identification | CLIP | OK |
| | COLP | OK |
| | CNIP | OK |
| | CONP | OK |
| Identification Restriction | CLIR | OK |
| | COLR | OK |
| Conference – CONF | | OK |
| Call Transfer – CT | | OK |
| Call Waiting – CW | | OK |
| Do Not Disturb – DND | | OK |
| Do Not Disturb Override – DNDO | | OK |
| HOLD | | OK |
| Message Waiting Indication – MWI | | OK |
| Direct Dialing In- DDI | | OK |
| Multiple subscriber number – MSN | | OK |
| Advice of charge – AOC D/E | | OK |
| Call Deflection – CD | | Not tested |
| Path Replacement – PR | | Not tested |
| Subadressing – SUB | | Not tested |
| User-User Signaling – UUS | | Not tested |

This supplementary service was not transferred because the voice gateway incorrectly processed the CCBS signaling request in SETUP message. On the other hand, the CCNR – Call Completion to Subscriber (in idle state) was transferred properly as it was indicated through MWI facility (Message Waiting Indication). Supplementary CD service was not tested as it is not supported by HiPath 4000.

**References:**

[1] ISO/IEC Standards, http://www.iso.ch/iso/en/ittf/PubliclyAvailableStandards
[2] ETS 300 172, *Inter-exchange signaling protocol,* ETS Institute, France, 1996
[3] PETERS J., DAVIDSON J.: *Voice over IP Fundamentals,* Cisco Press, Indianopolis USA, 2000, ISBN 1-57870-168-6
[4] VOZNAK, M.: *Comparison of H.323 and SIP Protocol Specification,* International Conference "Research in Telecommunication Technology 2003", STU Bratislava, September 2003, p. 45-47, ISBN 80-227-1934-X
[5] HiPath 4000 Service Manual, Siemens AG, Munich, 2002, P31003-H3101-K104-2-20
[6] Cisco Systems Inc., http://www.cisco.com